BSLP Fast Track Application

Marine ecological impact assessment

Prepared for: Beachlands South Limited Partnership

Prepared by: Tonkin & Taylor Ltd

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June 2026	0.1	Draft EcIA	Susan Jackson Mel Tupe	Dean C Miller	Mark Thomas
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Executive summary

Beachlands South Limited Partnership (BSLP) is lodging a substantive application under the Fast-track Approvals Act 2024 to enable the development of the Beachlands South Project. The Project will establish a comprehensively planned, public transport-focused community comprising approximately 2,000 residential dwellings, commercial and community facilities, schools, transport infrastructure, extensive ecological restoration areas, and associated three waters infrastructure. Potential marine ecology-impacts due to the Project include construction-phase earthworks, stormwater discharges, increased public access to the coastal environment, and the construction and operation of a treated wastewater ocean outfall within the Whitford Embayment.

This report presents a Marine Ecological Impact Assessment (EcIA) for the Project, undertaken in general accordance with the Ecological Impact Assessment Guidelines (EIANZ, 2018) and EcIA Module 1 for marine benthic habitats (EIANZ, 2024). This report supplements the Marine Ecological Impact Assessment prepared for Beachlands South Private Plan Change 88 (PPC88) (the PPC88 Marine EcIA), providing additional information on the subtidal marine environment within the Whitford Embayment, the proposed wastewater outfall and diffuser, and the potential ecological effects associated with the operational wastewater discharge. The assessment will inform the Assessment of Environmental Effects (AEE) supporting the Fast-track application.

This assessment draws on desktop investigations, previous ecological surveys undertaken for PPC88, targeted field investigations of the proposed outfall location (including sediment quality, benthic infauna and water quality sampling) together with wastewater discharge modelling to characterise the receiving environment and define a Zone of Influence (ZOI). The assessment identified that the Whitford Embayment supports a range of marine ecological values including soft sediment benthic habitats, subtidal seagrass, fish communities, foraging habitat for Threatened and At Risk seabirds and marine mammals.

Potential ecological effects identified in this EcIA include temporary construction effects associated with installation of the wastewater diffuser and pipeline, permanent occupation of a small area of seabed by the diffuser structure and permanent ongoing effects associated with treated wastewater discharges, including contaminant and nutrient inputs, potential effects of emerging organic contaminants, and effects on benthic habitats, fish, seabirds and marine mammals. For completeness, the report also summarises the construction earthworks, stormwater discharge and coastal access effects previously assessed as part of the PPC88 Marine EcIA.

A range of measures have been incorporated into the proposed wastewater construction and operation to avoid, remedy or mitigate adverse ecological effects. These include optimisation of the outfall location through extensive modelling; the proposed diffuser has been located to avoid sensitive marine habitats, including Marine Significant Ecological Areas (Marine SEAs) and identified subtidal seagrass beds.

Other effects management measures include installation methodologies that minimise disturbance to the coastal marine area, implementation of erosion and sediment controls during construction, stormwater treatment in accordance with Auckland Council guidance, and ongoing wastewater treatment designed to achieve high contaminant removal efficiencies. The Project also includes routine marine ecological monitoring with adaptive monitoring provisions, and residual effects management measures established through the Beachlands South Precinct provisions, including ecological enhancement and coastal bird management initiatives.

The marine ecological values, magnitude of effects and overall ecological effects following implementation of the proposed management measures are presented in Sections 4 to 6 of this report. Overall, the assessment concludes that the proposed wastewater infrastructure and associated discharges can be managed so that adverse effects on marine ecology are generally very low to low. Residual effects associated with enabling the wider urban development have previously been identified and are addressed through the established Precinct provisions, ecological compensation framework and ongoing monitoring and adaptive management. Accordingly, we are satisfied that adverse effects to marine and coastal ecological values due to the Project can be adequately addressed through the effects management measures outlined in this report and the established Precinct Provisions.

Marine Ecology: Statement of qualifications and experience

My name is Susan Elizabeth Jackson. I am a Senior Marine Ecologist at Tonkin & Taylor Limited (T+T), an environmental and engineering consultancy firm. I have been employed at T+T since October 2017. I have 14 years' experience in the field of Environmental Science and Marine Ecology as a consultant.

I have the following qualifications, experience, certifications, and professional memberships relevant to my evidence:

- I hold a Master of Science (First Class Hons) degree in Marine Science from the University of Auckland, graduating in 2016. My MSc research focussed on marine habitat classification and biodiversity prioritisation in the Tikapa Moana / Hauraki Gulf Marine Park using GIS and conservation decision making software.
- I have been a Certified Environmental Practitioner (#1523) since February 2022. I am a member of the Environment Institute of Australia and New Zealand (EIANZ), Environmental Defence Society (EDS), New Zealand Coastal Society (NZCS) and the Ornithological Society of New Zealand (Birds NZ).

Recent projects and services relevant to this engagement include:

- Lead author for the Beachlands Private Plan Change Application Marine Ecological Impact Assessment report, including effects to marine habitats, coastal vegetation, coastal avifauna and fish. Provided Evidence in Chief for the plan change hearing.
- SubCom subsea cable installation. Lead author of the marine ecological impact assessment report, including effects to sensitive subtidal habitats, seabirds and marine mammals.
- Auckland Downtown Infrastructure Development Programme (DIDP). The DIDP delivered a suite of projects in time for the 36th Americas Cup in 2021. My involvement included preparation of marine ecological assessments to inform Resource Consent for the Ferry Relocation project (Stage 1), Te Wānanga waterfront public space, Quay Street Enhancements stormwater outfall discharge and the Ferry Building section of the Quay Street seawall strengthening.
- Seaside Park critical coastal landfill remediation. This project required me to assess effects to marine ecology associated with remediation works to a coastal landfill and included work with engineers to design a reef platform adjacent to the site to create saltmarsh habitat.
- Glenbrook Steel Mill Discharge marine ecological effects assessment. I am an author of the marine ecological effects assessment, focussing on the effects to coastal avifauna and the subsequent residual effects management package to account for residual effects on coastal avifauna.
- Estuarine ecological effects assessment for a proposed Membrane Bio-Reactor (MBR) wastewater system at a location in the southern Manukau Harbour. I undertook the field survey and reporting to assess effects to an estuarine environment associated with discharges from an MBR wastewater system.
- Various small-scale projects pertaining to marine ecological effects assessments associated with a variety of activities including mangrove removal, dredging, structures in the Coastal Marine Area (CMA) and beach replenishments.

I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2023 and that I have complied with it when preparing ecological aspects of this report. Other than when I state I am relying on the advice of another person, this report is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

1 Introduction

1.1 Overview

This report has been prepared to inform a substantive application submitted by Beachlands South Limited Partnership ('BSLP') under the Fast-track Approvals Act ('FTAA'). The Project name is 'Beachlands South' and is included in Schedule 2 of the FTAA as a Listed Project with significant regional or national benefits. The Project location or Site is 110 Jack Lachlan Drive and 620, 712, 758 and 770 Whitford-Maraetai Road, Beachlands (the "Site" or the "project area").

The Project will provide for the development of live zoned land at Beachlands into a comprehensively planned and public transport focussed community to achieve a well-functioning urban environment comprising residential dwellings, a hotel and conference venue, community and commercial activities, protected ecological restoration areas, walking and cycling networks, and community facilities, and enable the potential development of two schools, as well as all associated earthworks and all associated infrastructure including transport facilities, intersection upgrades and roading, telecommunications, power, and water supply, stormwater, and wastewater infrastructure (including any treatment or storage facilities, drainage, pipes, pump stations, outfalls and discharges). A portion of Future Urban zoned land will be used for wastewater management purposes.

Key elements of the Project include:

- Residential activities comprising approximately 2,000 dwellings in a variety of housing types, densities and vacant sites for future residential development;
- Establishment of a commercial local centre supported by employment opportunities within and around the periphery of the local centre and on the Whitford-Maraetai Road frontage comprising approximately 27,000 m^2 of commercial GFA and 30,000 m^2 of light industrial GFA;
- Education facilities comprising the development of both primary and secondary schools;
- Establishment of an Ecological Protected Area Network (EPAN) comprising approximately 75 hectares of land being replanted, restored, maintained and enhanced including preservation of streams and their margins;
- A series of open spaces including a suburban park, neighbourhood parks, the Fairway Reserve, golf course, esplanade reserve and riparian margins;
- Provision of public access to and along the coastal marine area and the creation of a quality coastal pathway;
- Public transport enhancements and integrations including expanded ferry passenger capacity;
- Staged road upgrades including the provision of pedestrian and cycling facilities along Jack Lachlan Drive, the upgrade of Whitford roundabout, a series of intersection upgrades; and
- Establishment of infrastructure to service the project including wastewater, water supply, stormwater, telecommunications and power.

1.2 Report scope

BSLP has requested that T+T prepare a marine ecological effects assessment (this report) to inform the Assessment of Environmental Effects (AEE) that will assess the Fast Track application.

T+T previously prepared the Marine Ecological Impact Assessment for Beachlands South Private Plan Change 88 (PPC88) (the PPC88 Marine EcIA) to inform the rezoning of rural land to a combination of Business, Open Space, Residential and Future Urban Zone (FUZ) (T+T, 2022a). A full assessment of ecological values and potential effects to those values was provided in the PPC88 Marine EcIA. Further to the submission of that report, Susan Jackson also provided Evidence in Chief for the hearing panel to assess the application, which was granted with provisions as outlined in the Beachlands South Precinct Plan.

To complement the work undertaken to date and to supplement information already reported in the PPC88 Marine EcIA, this report provides:

- A description of the subtidal ecological values within the Whitford Embayment that may be impacted as part of activities authorised by the FTAA and were not previously described in the PPC88 Marine EcIA. **This information is outlined in Section 4.**
- A summary of the potential effects to ecological values associated with construction phase earthworks and ongoing stormwater discharges that were previously assessed as part of the PPC88 Marine EcIA. **This information is outlined in Sections 5.2.1 and 5.2.2.**
- A complete assessment of the potential effects to ecological values associated with construction of a wastewater diffuser pipe in the Coastal Marine Area (CMA) and the ongoing discharge of treated wastewater from the Combined Works Wastewater Treatment Plant (CW WWTP). **This information is outlined in Section 5.2.4.**
- A summary of the effects management required to address residual ecological effects following all efforts to avoid, remedy and minimise effects. This information is outlined in **Section 6**.
- The full PPC88 Marine EcIA is also provided in **Appendix F**.

1.3 Project description

To enable the development of the live zoned land at Beachlands South, activities with flow-on effects to marine ecology will be required; these include:

- Construction phase earthworks, generating additional sediment that discharges to the CMA via streams for the duration of the construction programme.
- Ongoing stormwater discharges from the finished development, increasing typical stormwater contaminants discharging to the CMA via stormwater pathways.
- Increased pedestrian access to the CMA and increased disturbance to significant and / or sensitive habitats and coastal avifauna.

The application also seeks to authorise an ocean outfall for treated wastewater and associated infrastructure, as well as the continuously pumped discharge. This activity includes:

- Directional drilling of approximately 1.5 km of submerged marine pipeline from the CW WWTP to a location in the centre of Whitford Embayment (see Figure 1.1). The pipeline will be entirely below the seabed.
- The pipeline will terminate below Mean Sea Level (MSL) with a multi-port diffuser system that maximises dilution and promotes vertical mixing. The diffuser is anticipated to be approximately 10 m in length.
- Proposed methodologies to install the diffuser port system include:
  - Construction of a temporary coffer dam, with associated dewatering to create a dry working environment.
  - Marine based installation with the diffuser pre-fabricated and transported to site, with installation via cranes and divers or remotely operated equipment positioning and connecting the pipe.

  The final installation methodology is proposed to be selected during detailed design with an expectation that construction of the coffer dam will be in the order of days, and full diffuser pipe installation to be in the order of months.

- The discharge to the CMA comprising wastewater treated via a CW WWTP located on the Site. Further details, including removal efficiencies of key contaminants, are included in **Section 3** and the report provided by Raath and Associates (2026a).

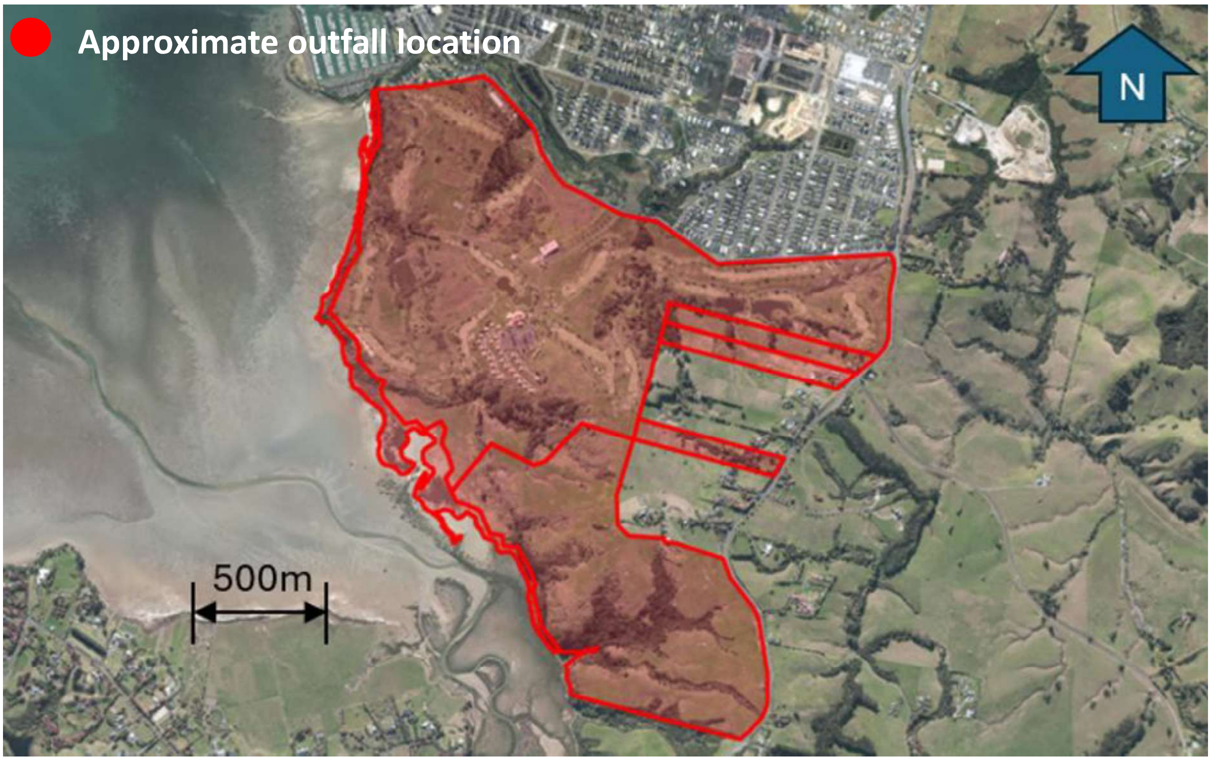

Figure 1.1: Project extent, also showing approximate outfall location

2 Ecological assessment methodology

This section outlines the literature reviewed and field investigations undertaken to inform the marine ecological values of the subtidal seabed at the location of, and in the vicinity of, the proposed ocean outfall.

The full methods for field investigations undertaken as part of the PPC88 Marine EcIA that informed values of the wider site and Zone of Influence (ZOI) are included in Appendix F and are not repeated here; they can be found in Section 2 of that report.

The methodology employed to undertake coastal modelling of the potential ZOI of the wastewater discharge is outlined in T+T report 'Water Quality Outfall Modelling Study' (T+T, 2026), with further information on this process outlined in Section 3.

2.1 Desktop review

Publicly available information and databases were reviewed to establish the ecological context of the subtidal marine environment and surrounds. This included a review of the following information:

- National Aquatic Biodiversity Information System (NABIS).
- Marine Mammal Database (DOC).
- Auckland Council State of the Environment reports (benthic ecology, sediment contaminants, water quality).
- Land Air and Water Aotearoa (LAWA) website (https://www.lawa.org.nz/)
- Auckland Council GeoMaps Significant ecological areas (SEAs).

- Marine Biosecurity Porthole (MBP) (https://marinebiosecurity.org.nz/)
- iNaturalist database (https://iNaturalist.org) and eBird database (https://ebird.org)

2.2 Field investigations

Targeted field investigations for the proposed ocean outfall were undertaken on 18 and 19 May 2026. The discharge site was accessed using a boat and samples or imagery collected included:

- Macroinvertebrate samples (3 replicates at each site)
- Sediment samples (metals, nutrients, grain size, Polycyclic aromatic hydrocarbons (PAH))
- Drop camera images at 45 randomised locations, with video imagery captured at an additional 12 locations.
- Water quality sampling at the ocean outfall discharge point (nutrient parameters)

Nine sample site locations were selected within 50 m of the discharge point to the north, south, east and west; these are included in Table 2.1 and shown in Figure 4.1.

Table 2.1: Marine sample site locations and parameters tested

Sample Site	Location	Sampled
Discharge point	1775364 Easting 5915809 Northing	Benthic infauna, Sediment quality (grain size, metals, PAH), water quality (nutrients and metals)
N10	10 m north of discharge point	Benthic infauna, Sediment quality (grain size, metals, PAH)
N40	40 m north of discharge point	Benthic infauna, Sediment quality (grain size, metals, PAH)
E20	20 m east of discharge point	Benthic infauna, Sediment quality (grain size, metals, PAH)
E50	50 m east of discharge point	Benthic infauna, Sediment quality (grain size, metals, PAH)
S10	10 m south of discharge point	Benthic infauna, Sediment quality (grain size, metals, PAH)
S40	40 m south of discharge point	Benthic infauna, Sediment quality (grain size, metals, PAH)
W20	20 m west of discharge point	Benthic infauna, Sediment quality (grain size, metals, PAH)
W50	50 m west of discharge point	Benthic infauna, Sediment quality (grain size, metals, PAH)

2.3 Sample collection and analysis

Sediment contaminant samples (metals and PAH), nutrients and grain size were collected to provide contextual data on the existing ecological health at the site, and within the context of the wider embayment. Benthic infauna cores were also collected at each of the sites to provide baseline information on the existing ecological status of the benthic communities.

2.3.1 Sediment quality

Composite surficial sediment samples (top 2 cm) were collected at each monitoring site (one per site) and sent to Hill Laboratories for grain size analyses and for a metal and nutrient suite analysis. Laboratory transcripts can be found in Appendix C.

Sediment contaminant concentrations have been compared against established sediment quality guidelines (SQGs) to assess the potential ecological risk. These guidelines provide thresholds that indicate the likelihood of adverse effects on benthic organisms residing in the sediment.

Three main SQG frameworks are used in Auckland, the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018), Environmental Response Criteria (ERC) and Threshold Effects Level (TEL) and Probable Effects Level (PEL) values (MacDonald et al., 1996).

Site specific sediment indicator thresholds have also been developed for expected ecological quality status, as outlined in 'Advice on Indicators, Thresholds and Bands for Estuaries in Aotearoa, New Zealand' (Stevens et al., 2024). These thresholds have been referred to for sediment Total Nitrogen (TN) and Benthic Health Model (BHM) scores.

For copper, lead and zinc, the ERC developed by Auckland Regional Council (ARC, 2004) are used. The ERC guidelines are region-specific and more conservative than the ANZG values, designed to provide early warning of environmental degradation. The ERC categorises contaminant levels into three bands:

- Green: low impact, minimal ecological risk.
- Amber: moderate impact, potential early signs of ecological stress.
- Red: high impact, likely ecological degradation.

The ANZG are applied to all metal analytes. These guidelines include Default Guideline Values (DGVs), which represent concentrations below which adverse ecological effects are unlikely, and upper guideline values (GV-high), above which toxic effects may be expected (Allen, 2024).

For chromium, mercury, cadmium and nickel, the ANZG (2018) are applied as there are no ERC guidelines developed. The TEL/PEL guidelines are considered similarly conservative as early warning indicators. The TEL represents concentrations below which adverse effects are rarely observed, while the PEL indicates levels above which adverse effects are frequently observed in benthic communities (Allen, 2024). The TEL/PEL guidelines have not been used in this assessment as the ERC and ANZG guidelines provide sufficient thresholds for the analysis of the marine sediments collected.

The above guidelines are used to classify sediment quality at each site and inform the interpretation of ecological risk due to the proposed activities. The specific threshold values applied are summarised in Table 2.2.

Table 2.2 Environmental Response Criteria (ERC) and Australian and New Zealand Guidelines (ANZWQG) for metals. DGV=default guideline values, GV-High=guideline value high (Allen, 2024; ANZG, 2018).

Metals	ERC (mg/kg)			ANZG (mg/kg)		
	Green	Amber	Red	DGV		GV-High
Copper	<19	19-34	>34	<65	65-270	>270
Lead	<30	30-50	>50	<50	50-220	>220
Zinc	<124	124-150	>150	<200	200-410	>410
Arsenic	No ERC values			<20	20-70	>70
Chromium	No ERC values			<80	80-370	>370
Mercury	No ERC values			<0.15	0.15-1	>1
Cadmium	No ERC values			<1.5	1.5-10	>10
Nickel	No ERC values			<21	21-52	>52

PAHs are assessed in the first instance against laboratory detection limits, and then against ANZG default guideline values Low (DGV - Low) and Guideline Values - High (GV-high) and ERC guidelines. The totals for ANZG are derived from 18 parent PAHs[1] and ERC guidelines are derived from six parent PAHs[2]. Sediment quality guideline concentrations for PAHs as per the Auckland Council ERC[2] and ANZG Sediment Default Guideline Values (DGV) – low and GV – High) are outlined in Table 2.3.

Table 2.3 Sediment quality guideline concentrations for total PAHs for the ERC guidelines[2] and for the ANZG guidelines[3]

Contaminant	Unit	Auckland Council ERC			ANZG (2018) Sediment DGV-low	ANZG (2018) Sediment GV-high
		Green	Amber (TEL)	Red (ERL)		
Total PAHs	mg/kg dry weight	< 0.66	0.66 - 1.7	> 1.7	10	50

2.3.2 Benthic infauna

Infaunal cores were collected at each of the nine monitoring sites. Three replicate benthic cores were collected from each station using a petite ponar grab sampler. Each core was sieved through 0.5 mm mesh with the remaining material preserved using 60 - 70 % ethanol in seawater. Samples were delivered to Biolive Limited for identification of macroinvertebrates. The raw results can be found in Appendix C.

Macrofaunal community composition was analysed using multivariate methods in RStudio. Species abundance data was square-root transformed to reduce the influence of dominant taxa. Bray–Curtis dissimilarities were calculated and used to test for differences among sites using PERMANOVA (adonis2, 999 permutations). Homogeneity of multivariate dispersion was assessed using betadisper. Community patterns were visualised using a Principal Coordinates Analysis (PCoA) with an additive correction for non-Euclidean distances, and the proportion of variation explained by each axis was reported. Species contributions to ordination structure were examined using envfit (999 permutations), with only significant and high-contributing taxa ($p \leq 0.01$; upper quartile of vector lengths) displayed as rescaled vectors on ordination plots.

In addition to multivariate analysis, average species abundance and relative abundance of benthic infauna are reported. Shannon-Wiener diversity and evenness indices were derived for benthic infauna cores. These indices are commonly used to describe community complexity and equitability of distribution, where the diversity value ranges between 0 (indicating low community complexity)

[1] Naphthalene, acenaphthylene, acenaphthene, fluorene, anthracene, phenanthrene, fluoranthene, pyrene, benz[a]anthracene, chrysene, benzo[a]pyrene, perylene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[e]pyrene, benzo[ghi]perylene, dibenz[a,h]anthracene and indeno[1,2,3-cd]pyrene.

[2] Auckland Council ERC High molecular weight (HW) PAH guidelines are ascertained from the sum of the concentrations of six PAH's benzo(a) anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene and pyrene (as defined in ANZECC 2000) (Mills et al., 2012).

[3] The DGV and GV-high values for total PAHs (sum of PAHs) include the 18 parent PAHs: naphthalene, acenaphthylene, acenaphthene, fluorene, anthracene, phenanthrene, fluoranthene, pyrene, benz[a]anthracene, chrysene, benzo[a]pyrene, perylene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[e]pyrene, benzo[ghi]perylene, dibenz[a,h]anthracene and indeno[1,2,3-cd]pyrene. Where nonionic OCs like PAHs are the dominant chemicals of potential concern (COPCs), the use of equilibrium partitioning sediment benchmarks (ESBs) is desirable, which includes a further 16 alkylated PAHs (generally listed as C1-/C2-/C3-/C4-alkylated), as described in Appendix A3 of Simpson et al. (2013a).

and 4 (indicating high complexity); whilst the evenness value ranges from 0 (highly irregular distribution) to 1 (all counts are equal).

2.3.2.1 Benthic Health Model

The National Benthic Health Model (BHM) is a standardised, national-scale tool used to assess estuary health in Aotearoa New Zealand based on the composition and abundance of benthic macrofauna. It uses multivariate models to translate community structure into a score (from 1 to 6) that reflects the relative impact of key stressors—specifically sedimentation (Mud BHM) and heavy metal contamination (Metals BHM) on ecological integrity, with higher scores indicating greater impact. Rather than relying on fixed reference conditions, the models evaluate sites along stressor gradients observed across many estuaries, allowing comparison to sites nationally.

Benthic Health Model (BHM) scores range from 1 (least impacted) to 6 (most impacted) and indicate how strongly macrofaunal communities are affected by sedimentation or metals relative to other estuarine sites in Aotearoa New Zealand. Scores can be grouped into categories from very low to very high impact, but these are based on divisions along a stressor gradient rather than fixed ecological thresholds, meaning they reflect relative, not absolute, health (Table 2.4).

Table 2.4: Descriptive names and boundaries for Benthic Health Model (BHM) score categories

BHM Group	Level of impact relative to other estuarine sites in New Zealand*	BHM Score
1	very low	1 to <2
2	low	2 to <3
3	moderate	3 to <4
4	high	4 to <5
5	very high	≥5

Note:* This is a relative measure of impact rather than an absolute measure of health

2.3.3 Water quality

A single water quality sample was collected at the discharge point location on 18 May 2026 and sent to Hill Laboratories for nutrient and metal suite analysis. Laboratory transcripts can be found in Appendix C. Water quality results have been compared to Auckland Council marine monitoring guidelines (which in turn refer to Australia and New Zealand Guidelines for Fresh and Marine Water Quality) and site-specific water column indicator thresholds for estuaries in New Zealand (Foley et al., 2018 and Stevens et al., 2024)[4].

[4] Only TP results were able to be interpreted for the purposes of this assessment due to a laboratory processing issue.

Table 2.5: Site specific water column indicator thresholds referenced from Stevens et al. (2024)

Indicator		Metric	Ecological Quality Status				
			Very Good	Good	Fair	Poor	Very Poor
Water column indicators	Potential TN (mg/m^3)	Euhaline (>30ppt)	<30	≥30 to 75	≥75 to 110	>110	-
	Potential TP (mg/m^3)	Euhaline (>30ppt)	<4	≥4 to 10	≥10 to 15	>15	-

2.4 Approach to ecological impact assessment

The method applied to this EcIA broadly follows the Ecological Impact Assessment Guidelines (2018) (EcIAG) published by the Environment Institute of Australia and New Zealand (Roper-Lindsay et al., 2018) and the EcIA Module 1 which assigns ecological values to marine benthic habitats (EIANZ, 2024). The guidelines provide a standardised framework and matrix allowing a consistent and transparent approach to the assessment of ecological effects.

The guidelines were used to establish the following:

- The ecological values of marine species and subtidal habitats within the ZOI (refer to Appendix A Table 1 and Appendix A Table 2 and description of ZOI in Section 5.1.2.).
- The magnitude of effect (refer to Appendix A Table 3) on ecological values from the proposed activity with proposed and/or recommended management measures in place. The magnitude of effects assessment is based predominantly on the spatial scale, intensity, frequency, timing and level of confidence surrounding the effect.
- The overall level of effects to determine whether further avoidance, remediation or mitigation is required and where there are residual adverse effects that should be offset or compensated (Appendix A Table 4).

Refer to Appendix A for the criteria and tables used in this assessment.

The ZOI refers to the receiving environment that could potentially be impacted by the project (Roper-Lindsay et al., 2018), this includes all estuarine and marine water bodies and environments that could potentially by affected by the Project; the ZOI is described in Section 5.1.2.

The methods in this report are consistent with those outlined in the PPC88 Marine EcIA, which is provided in Appendix F.

2.5 Approach to residual effects management

Determining the type and magnitude of marine habitat and enhancement measures to address residual effects associated with the proposed activity that cannot be avoided, remedied or mitigated will be guided by the application of a Biodiversity Compensation Model (BCM) (Baber et al. 2021). These models provide additional objective transparency, process and justification for the overall compensation package (Baber et al. 2021). In summary, BCMs:

- Provide guidance on addressing all residual adverse effects associated with a project for which impacts or gains cannot feasibly be measured or quantified with adequate precision and for which residual effects management is deemed appropriate when assessed against the 'limits to offsetting' principle.
- Serve as a decision support tool that provides additional transparency and rigour to the process of addressing residual adverse effects on biodiversity through compensation measures at proposed habitat restoration/enhancement site(s).

- Provide guidance on whether Net Gain (NG) outcomes are expected to be achieved for specified biodiversity values. Expected NG outcomes are sought, rather than No Net Loss (NNL) outcomes, to provide more confidence that NNL will actually be achieved.
- Operate at the 'as close to offset as possible' end of the compensation continuum. This is termed 'biodiversity compensation' in the National Policy Statement – Indigenous Biodiversity (NPS-IB)(MfE, 2023).
- Operate across the full spectrum and scale of project optioneering and plan change or consent applications.
- Can be later used to verify offsetting based on real data that is collected after the commencement of habitat restoration and enhancement activities at proposed offset/compensation sites.

The approach to residual effects in this report is consistent with that outlined in the PPC88 Marine EcIA, which is provided in Appendix F.

3 Wastewater discharge coastal modelling summary

Coastal modelling of the proposed wastewater discharge from the ocean outfall location in Whitford Embayment has been undertaken to understand the potential spatial scale of the effect associated with the continuous discharge of treated wastewater to the CMA. Full details of the coastal modelling are provided in T+T report 'Water Quality Outfall Modelling Study' (T+T, 2026) and a summary is provided here.

The report outlines the study, which utilises a conservative tracer to simulate the dispersion and dilution of the proposed wastewater discharge under a range of tidal, meteorological, and flow conditions. This work is separate to coastal modelling previously undertaken to inform PPC88, which outlined model scenarios associated with construction phase earthworks and ongoing stormwater contaminants. The outputs from that work were described previously (in T+T 2022b) and were used to inform the PPC88 Marine EcIA (Appendix F). The report outputs are therefore not repeated here.

Treated effluent discharge parameters were provided as a basis for the 2026 study, including BOD, TSS, Total Nitrogen, Total Phosphorus and Faecal Coliforms (refer to Table 3.1 and Raath and Associates (2026a)).

Table 3.1: Average wastewater discharge water quality constituent concentrations (Raath and Associates, 2026a)

Water quality constituent	50^{th} percentile	80^{th} percentile	90^{th} percentile	Plant failure concentrations	Plant failure description
Total Nitrogen (TN) (mg/L)	3	6	8	10	Circulation Pump Failure
Total Phosphates (TP) (mg/L)	3	4	5	10	Circulation Pump Failure
Total suspended solids (TSS) (mg/L)	3	4	5	8	Reactor Media Failure
BOD_5 (mg/L)	2	3	3	3	Reactor Media Failure
Faecal coliforms (CFU/100 mL)	1	2	2	200	UV disinfectant

To inform model inputs, specific water quality guidelines were interrogated to apply appropriate thresholds in the study, including:

- Wastewater Environmental Performance Standards (WEPS) Regulations 2025 (applicable to publicly owned wastewater treatment plants), which stipulates concentration limits for consenting of public discharges.
- Advice on Indicators, Thresholds and Bands for Estuaries in Aotearoa New Zealand (Stevens et al., 2024). This report outlines proposed thresholds for commonly used estuarine ecological indicators, including nutrients in sediment and the water column.
- Auckland Council marine water quality state and trends reporting which provides guidance on specific water quality contaminants and thresholds that are also based on the Australia and New Zealand guidelines for fresh and marine water quality (Foley et al., 2018).

Importantly, the study takes into account ambient (background) water quality for TN, TP, TSS and DO, as derived from monthly water quality monitoring undertaken by Auckland Council at the mouth of the Turanga Estuary from 2009 to 2015. Routine water quality monitoring at this site has since been discontinued, however the data set is appropriate for referencing in this report on the basis that it is within the Whitford Embayment and close to the proposed wastewater discharge location, and contains a large dataset (monthly) from which to derive results. Water quality parameters at other current Auckland Council marine water quality sites in the Tāmaki Estuary and Wairoa River have also been reviewed for completeness.

A summary of key inputs and results from the study are provided here:

- Through the development of the study, a daily discharge volume of 4,000 m^3 was modelled. Subsequent discussions indicate that the actual average daily discharge rate is 1,374 m^3, however the original model outputs were retained to provide further certainty around future development options, which are not part of this application. The modelled discharge outputs therefore provide a conservative basis for this assessment against relevant guideline concentrations.
- Background concentrations of TN and TP have been added to modelled concentrations before comparison with published guideline values, correlating to "fair" water quality conditions (as per Stevens et al., 2024).
- Modelled concentrations for the various pollutants are provided at the boundary of a mixing zone 100 m in radius encircling the discharge location using the highest concentration modelled.
- Highest modelled discharge concentrations occurred under dry weather conditions during neap tides (when tidal ranges are smallest) and at low-water slack tide (when current velocities are lowest). In this instance (considered to be the most conservative, or 'worst case), the discharge is expected to be diluted by 850-fold (80th percentile) at the extent of the mixing zone (Figure 3.1).
- The model simulation did not identify an accumulation of discharge in the model domain, meaning nutrients in the water column did not accumulate over time.
- Moving the discharge location did not change the general direction of flow, and dilution factors remained high (over 1000-fold). This result provides confidence that should there be a future requirement to alter the proposed location of the discharge pipe (i.e. moving the pipe up to a hundred meters in either direction) that the potential ecological effects would not materially change.
- Wind does have an effect on the discharge, with treated wastewater generally spreading in the direction of wind, however the wind effect also increased the dilution factor.

The outputs of the modelling study are important for contextualising the spatial scale of potential effects to marine ecological values and are discussed further in Sections 5.1.2 and 5.2.4. The following conclusion from the modelling report is noted:

> *"The analyses indicate that changes in the concentrations of the water quality constituents assessed at the edge of the mixing zone, resulting from the discharge, are below laboratory detection limits. These changes are substantially lower than guideline values. Background (existing) concentrations remain the primary determinant of overall water quality in this area."*

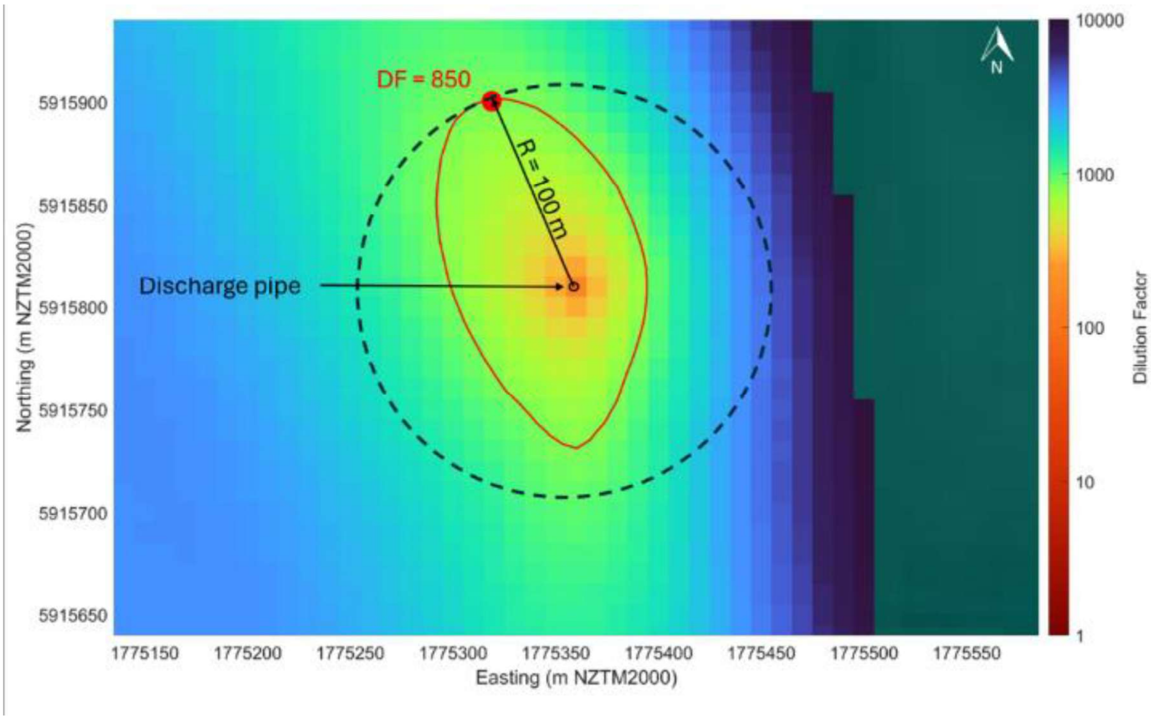

Figure 3.1: 80th percentile dilution factor figure, showing minimum 850 dilution factor at 100 m from the discharge location. Dilution factors less than those shown occur 20 % of the time.

4 Marine ecological characteristics and values

The marine ecological values described here are in addition to those previously outlined in the PPC88 Marine EcIA, including a description of the subtidal benthic habitat, water quality, seabirds and marine mammals that were not previously described.

Intertidal habitats, wading birds and coastal saline vegetation values are described in the PPC88 Marine EcIA in Appendix F.

4.1 General marine environment

Jack Lachlan Esplanade Reserve is located adjacent to the Waikopua Creek and along the coastal margin to the west of the Formosa Golf Course at 110 Jack Lachlan Drive and the neighbouring property at 620 Whitford-Maraetai Road. The coastal area is part of the Hauraki Gulf Marine Park[5] and comprises three distinct tidal creeks (Waikopua, Turanga and Maungamaungaroa Creeks) which are identified as being regionally and nationally significant. The three tidal creeks discharge into the Whitford embayment, a drowned valley estuary, which is approximately 11.1 km^2, with a mean tidal range of 2.4 m and a catchment area of 61 km^2 (Thrush *et al.*, 2003).

Eight Significant Ecological Areas - Marine (SEA-M) are recognised by the AUP; these are included in Appendix F Table 1 and shown in Appendix F F1 Figure Extract from Volume 2 Appendices.

Turanga Creek is the largest estuarine habitat (including mangrove shrubland ecosystems), in the Hunua Ecological District and provides a complex of intertidal mud, sand and shell flats. The intertidal banks are a very rich feeding ground and important mid-tide roost for a variety of international migratory and New Zealand endemic wading birds including a number of threatened species. A large shellbank at the Waikopua Creek mouth is used as high tide roost by birds. Moderate numbers of wading birds roost on the shellbanks including godwit, South Island pied oystercatcher, whimbrel, reef heron, variable oystercatcher and banded dotterel. The length of coastline adjacent to the site is recognised as an extensive area of feeding habitat for wading birds.

4.2 Subtidal marine habitats

Subtidal marine habitats were sampled on 18 and 19 May 2026 using the methods described in Section 2.2 above. The sample and drop camera imagery locations are shown in Figure 4.1.

[5] The Whitford Embayment is not located with a Marine Reserve, High Protection Area or Seafloor Protection Area under under the Hauraki Gulf/Tīkapa Moana Marine Protection Act.

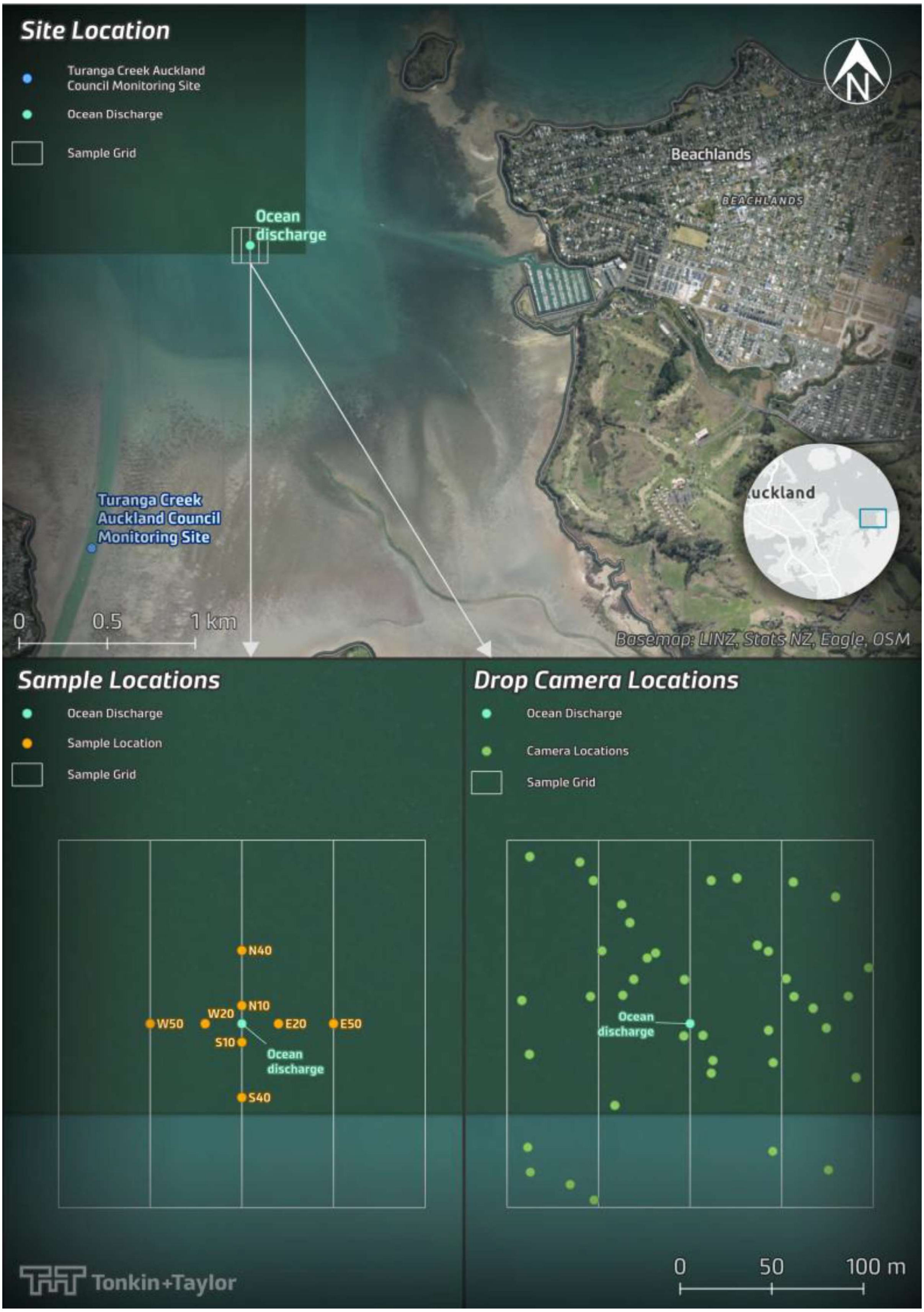

Figure 4.1: Ocean discharge location with associated benthic infauna and sediment quality sample locations (100 m by 100 m grid) and randomised drop camera photo point locations (200 m by 200 m grid)

4.2.1 Benthic fauna

4.2.1.1 Benthic epifauna and epiflora

Drop camera images were collected from 45 locations within a 200 m grid around the proposed discharge location (Figure 4.1). At 12 of these locations a short video was taken to capture additional habitat information.

The photos and the video show numerous burrow holes and soft sediment indentations in all of the imagery captured (Photograph 4.1 - Photograph 4.8). There were only two organisms seen on the surface, one cushion star (*Patriella resularis*) (Photograph 4.7) and potentially two *Sabella spallanzanii* which form a long leathery flexible tube positioned within the sediment (Photograph 4.6) (Read et al., 2011; BNZ, 2024).

While no other species were detected, the observed burrow holes may have been created by a variety of soft-sediment species, by fish foraging on the benthic surface, or by rays forming feeding pits. The burrow holes could also be attributed to ghost shrimp (*Filhollianassa filholi*), mud shrimp (*Upogebia hirtifrons*) and the heart urchin (*Echinocardium cordatum*) (McLeod et al., 2024) which are found burrowing in soft sediment, crabs such as the stalk-eyed mud crab (*Hemiplax hirtipes*), or bivalves species such as *Macamona liliana*. In some locations there were radial macrofauna feeding marks or bioturbation (the active rework and redistribution of surface sediments) which could be derived from bivalve, urchins or crab species such as those mentioned above (Hewitt et al., 2012; McLeod et al., 2024; Needham et al., 2011; Rowden, 2017).

Mud shrimp were described by Morton and Miller in 1973 distributed across the shore at Howick. They are known to build large burrows in mud, sometimes with multiple entrances, containing wide turning chambers (Morton and Miller, 1973; Coelho et al., 2000).

Photograph 4.1 Drop camera image from the proposed discharge location

Photograph 4.2 Drop camera image from 40 m South location

Photograph 4.3 Drop camera image 20 m East location

Photograph 4.4 Drop camera image 40 m North location

Photograph 4.5 Drop camera image at location number 40

Photograph 4.6 Drop camera image at location number 36, showing the two potential S.spallanzanii in the background

Photograph 4.7 Image capture from within a video showing a cushion star.

Photograph 4.8 Image capture from within a video

4.2.1.2 Benthic infauna

Three macroinvertebrate samples were collected from each of the nine sampling sites (Appendix B), with the data averaged and presented in the graphs below. Macroinvertebrate communities exhibited some spatial variability across the study area, with abundance ranging from an average of 19 to 46 individuals per site, highest at N-40 and D, and lowest at W-20 and S-40 (Figure 4.2). Taxa richness was relatively consistent (between an average per site of 8–12 taxa), indicating broadly similar community composition across sites, although slightly reduced richness was observed at S-40 and W-20 (Figure 4.3). Shannon–Wiener diversity indices were also comparable (approximately 1.9–2.5), suggesting broadly similar ecological structure, with minor reductions in diversity at W-50 and S-40 (Figure 4.4). Evenness values were generally high (0.65–0.90), indicating relatively even distribution of individuals among taxa at most sites, although some dominance by fewer taxa was evident at W-50 and N-40 (Figure 4.5).

Macroinvertebrate communities were broadly similar across the study area, with moderate abundance, richness and diversity consistent with healthy soft-sediment habitats. Minor spatial differences between sites likely reflect natural variability in habitat conditions rather than evidence of ecological degradation or localised disturbance.

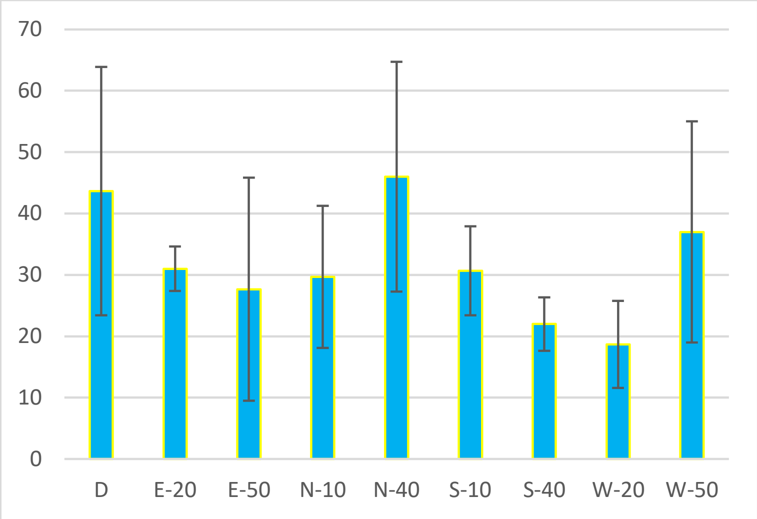

Figure 4.2 Average number of macroinvertebrate individuals per site (3 replicates) with standard deviation bars

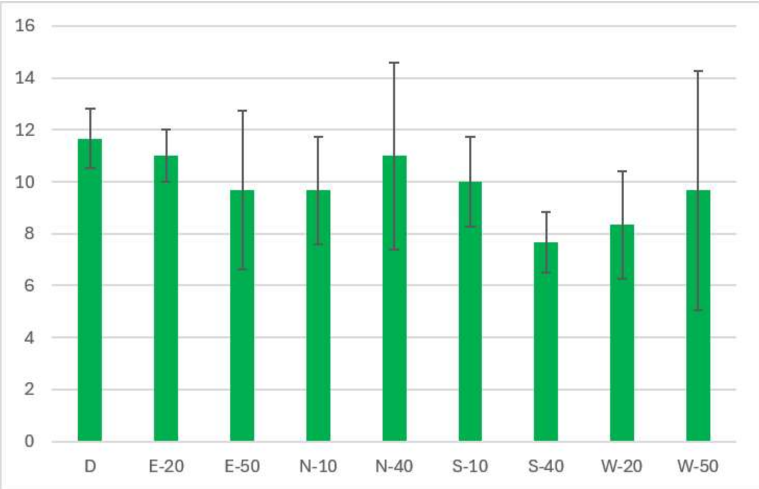

Figure 4.3 Average number of macroinvertebrate taxa per site (3 replicates) with standard deviation bars

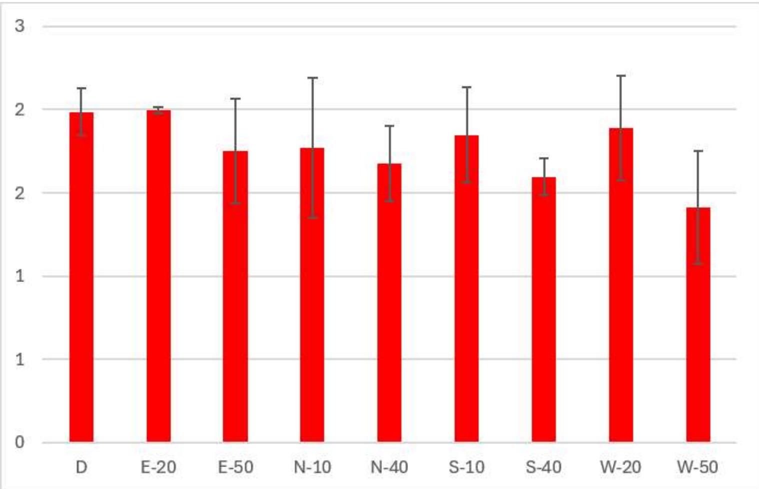

Figure 4.4 Average Shannon Weiner diversity per site (3 replicates) with standard deviation bars

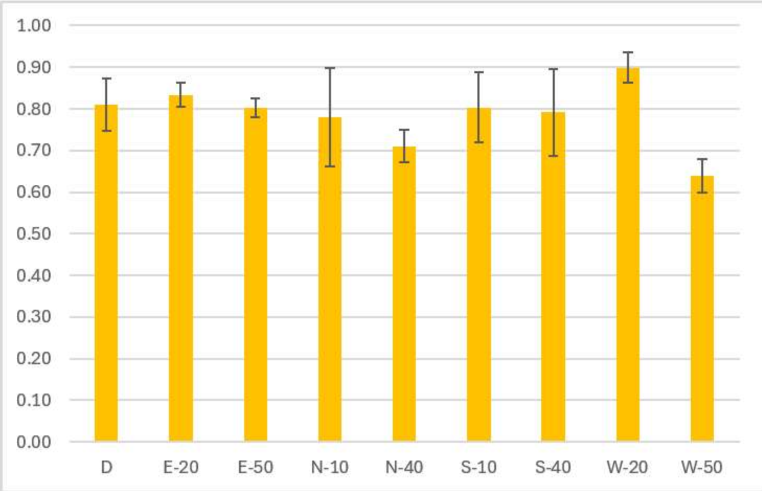

Figure 4.5 Average Shannon Weiner evenness per site (3 replicates) with standard deviation bars

PERMANOVA indicated that infaunal community composition did not differ significantly among sites (pseudo-$F_{8,18}$ = 1.15, p = 0.213), with Site explaining 33.8% of the variation in Bray–Curtis dissimilarities. The majority of variation was attributed to within-site differences (66.2%). Test of multivariate dispersion showed no significant differences in community variability among sites (ANOVA: $F_{8,18}$ = 0.47, p = 0.864; permutation test: p = 0.849), indicating that the non-significant PERMANOVA result was not confounded by heterogeneity of dispersion. Together, these results suggest that macrofaunal assemblages were broadly similar across sites.

The PCoA ordination indicated weak spatial structuring of macrofaunal assemblages, with considerable overlap among sites (Figure 4.6). The first two axes explained a modest proportion of the variation in community composition (PCoA1 = 21.8%, PCoA2 = 11.1%), and did not clearly separate sites into distinct groupings. Samples from several sites (e.g., D, E20, E50, N10, and S10) were interspersed across the ordination space. Fitted species vectors indicated that variation along the ordination was weakly associated with the distribution of key taxa, with *Theora lubrica* aligned with positive PCoA2 and *Heteromastus filiformis* associated with negative PCoA2 scores. However, there was no overall pattern, consistent with PERMANOVA results indicating no significant differences in community composition among sites.

These results indicate that of the 9 sites sampled, there were no statistically significant patterns or differences in community composition i.e. the sites are similar to each other.

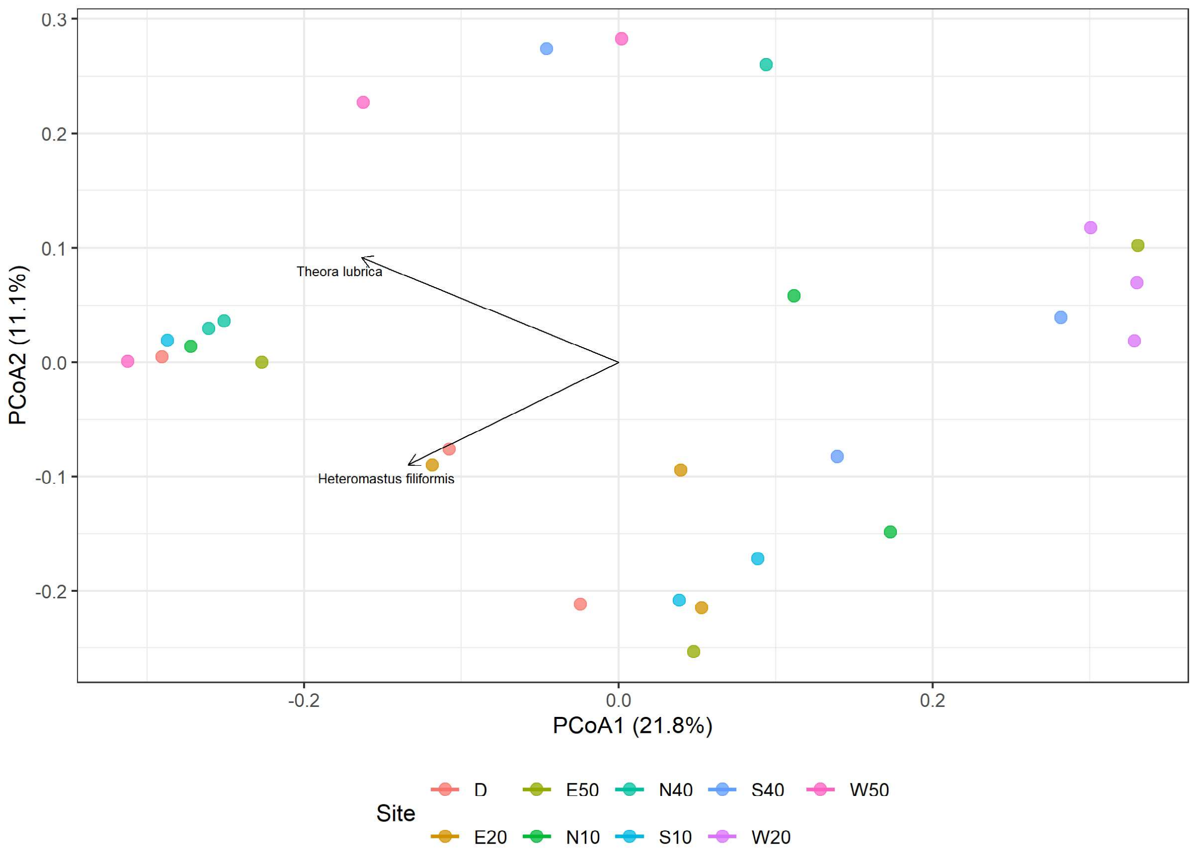

Figure 4.6: Principal coordinates analysis (PCoA) based on Bray–Curtis dissimilarities for multivariate macrofauna assemblage patterns across sites. The two axes explaining 21.8% (PCoA1) and 11.1% (PCoA2) of variation in the dissimilarity matrix (32.9% cumulative). Species vector overlays filtered to show p ≤ 0.01 and upper-quartile vector lengths, rescaled for readability.

4.2.1.3 Benthic Health Model

Auckland Council utilise the Benthic Health Model (BHM) to classify its intertidal/marine monitoring sites according to relative ecosystem health. This is based on a site's community composition and the predicted response to stormwater contamination. The BHM facilitates recognition of temporal trends in ecosystem health at sites that are routinely monitored.

A key limitation of the National Benthic Health Models (BHM) is that not all taxa present in a sample can be incorporated into the analysis, because some species cannot be confidently assigned to the required taxa categories. When taxa are omitted—either due to insufficient taxonomic resolution, mismatches with the predefined categories, or the species is not present in the modelled data—they are not used to calculate BHM scores, which can reduce the completeness of the ecological signal.

Across the 9 sampled sites, 12 taxa were excluded from the BHM model due to a combination of species absent from the model, or the taxonomic resolution too broad to accurately assign to the BHM categories. Most of these excluded species were low in abundance (an average of ≤1 per site) besides Scleroconcha sp. which had average abundances between 2 – 5 per site. The unassigned groups represent 26 % of the overall number of taxonomic groups identified across sites. An additional 5 taxonomic groups were intentionally removed from the BHM analysis as these were either insect larvae or meiofauna that are not included in the model. The Metals BHM scores were well fitted to the model based on the diagnostic plot output.

BHM scores should be interpreted with caution as these sites are subtidal, and BHM modelled data is primarily based on intertidal sites. Although the included data sets are generally a good fit with the modelled data, the subtidal locations have likely increased the number of taxa that were removed from the analysis. Additionally, there was a dominance in the bivalve species *Theora lubrica* that has slightly skewed outputs.

Mud BHM scores ranged from 4.33 to 5.26, indicating consistently high to very high relative impacts of sedimentation across all sites. Four sites (D, E20, E50, and N40) were classified as very high for mud, while the remaining five sites were classified as high. Metal BHM scores ranged from 3.61 to 5.02, showing slightly more variation, with most sites (7 of 9) classified as high, E50 classified as moderate, and D classified as very high.

Notwithstanding some of the above-mentioned limitations of the BHM, it is a relative measure of impact rather than an absolute measure of health and is useful to contextualise results from this study. These results indicate generally high to very high levels of impact from mud and metals relative to other estuarine sites in New Zealand.

Table 4.1: BHM Mud and BHM Metal outputs for nine benthic infauna sample sites

Site	BHM Mud	BHM Mud Category	BHM Metal	BHM Metal Category
Discharge point	5.1	Very high	5.0	Very high
E20	5.0	Very high	4.2	High
E50	5.3	Very high	3.6	Moderate
N10	4.8	High	4.8	High
N40	5.2	Very high	4.8	High
S10	4.9	High	4.0	High
S40	5.0	High	4.4	High
W20	4.3	High	4.7	High
W50	5.0	High	4.2	High

Note:

4.2.2 Sediment quality

4.2.2.1 Metals and Polycyclic Aromatic Hydrocarbons (PAH)

Sediment analysis for heavy metal suite was carried out for one sample per monitoring site and analysed by Hill Laboratories. Analytes tested for included arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc. No exceedances above the ERC green or DGV / GV-High guidelines were detected (Table 4.2).

Sediment contaminant results showed low variability across all sites and contaminants and did not record any high levels or outliers within the data. Observed concentrations were tightly clustered indicating relatively homogeneous sediment conditions within the investigation area.

These results indicate that there is a low impact or likelihood of effects to marine species due to metal and PAH contaminants.

Table 4.2 Sediment analysis for heavy metals compared against ERC guidelines for (copper, lead, zinc) and ANZG guidelines for (arsenic, cadmium, chromium, mercury and nickel).

Site	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Zinc (mg/kg)
D	5.4	0.033	14	4.7	9.2	0.06	5.4	40
N-10	5.2	0.03	14.5	4.6	9.2	0.06	6.2	39
N-40	5.1	0.032	13.8	4.6	9.1	0.06	5.4	39
W-20	5.3	0.035	12.5	4.4	8.9	0.06	5.3	38
W-50	4.7	0.029	11.9	4	8.3	0.05	4.7	36
E-20	4.9	0.029	14.5	4.7	9.6	0.06	5.4	40
E-50	5.1	0.03	13.5	4.7	9.2	0.06	5.3	41
S-10	5.5	0.031	14.9	4.9	9.5	0.06	5.6	41
S-40	5.7	0.029	13.4	4.7	9.6	0.07	5.3	42

Sediment analysis for PAHs was carried out for one sample per monitoring site and analysed by Hill Laboratories. PAHs were assessed against ERC and ANZG DGV and GV-High guidelines. No exceedances were detected (Table 4.3).

Table 4.3 Sediment analysis for PAHs compared against ERC and ANZG guidelines.

Site	ERC	ANZG
D	0.036	0.139
N-10	0.032	0.046
N-40	0.034	0.059
W-20	0.012	0.029
W-50	0.008	0.055
E-20	0.004	0.059
E-50	0.015	0.027
S-10	0.030	0.166
S-40	0.038	0.029

4.2.2.2 Nutrients

Analysis of nutrients in sediment samples was undertaken with reference to guidelines for estuaries presented within Stevens et al, 2024 which sets out site specific sediment indicator thresholds. Noting that no guidelines thresholds are currently available for total recoverable phosphorus (TRP). Total nitrogen (TN) were reasonably consistent across all sites (600-700 mg/kg) and fall within the 'good' ecological quality status. Total organic carbon (TOC) ranged between 0.47% to 0.61% with most sites classified as 'good; ecological quality status and two sites (N-10 and W-50) classified as 'very good' (Table 4.4). Both these measures indicate that sediments are well oxygenated and ecological communities are at low risk of losing sensitive species.

TRP concentrations ranged between 280 to 340 mg/kg and while there are no formal thresholds for classification, these results are within a relatively narrow range across the study area, indicating spatially consistent phosphorus levels with no evidence of localised enrichment at any of the sites. TRP concentrations were lower when compared with another study of central Auckland estuaries, basins and beaches which dataset showed results between 383-767 mg/kg (Simha, 2025). This suggests that the TRP concentrations are comparatively low, and do not indicate localised enrichment.

Sediment nutrient concentrations were low and consistent across the study area, with total nitrogen and total organic carbon indicating good to very good ecological condition and well-oxygenated sediments that support healthy benthic communities. Total recoverable phosphorus was also spatially consistent and comparatively low relative to other Auckland estuaries, providing no evidence of localised nutrient enrichment.

Table 4.4: Nutrient concentration results for total recoverable phosphorus (mg/kg), total nitrogen (mg/kg) and total organic carbon (%).

Site	Total recoverable phosphorus (mg/kg)	Total nitrogen (mg/kg)	Total Organic Carbon (%)
D	280	700	0.53
N-10	300	600	0.47
N-40	280	700	0.52
W-20	310	700	0.51
W-50	290	600	0.48
E-20	320	700	0.61
E-50	340	700	0.54
S-10	310	700	0.53
S-40	340	700	0.52

4.2.2.3 Phytoplankton biomass indicators: Chlorophyll *a* and Pheophytin

Elevated concentrations of chlorophyll *a* can reflect an increase in nutrient loads and increasing trends can indicate eutrophication of aquatic ecosystems. Pheophytin *a* is sampled alongside chlorophyll *a* as it is a common degradation product of, and can interfere with the determination of, chlorophyll *a*.

Chlorophyll *a* and pheophytin *a* concentrations varied across the sampling sites, with values ranging between 3.5 - 6.1 mg/kg for chlorophyll *a* and 4.5-8.7 mg/kg, which was comparable to the Waikopua estuary sites that were sampled in 2021 as part of the PPC88 project (chlorophyll *a* ranged between 4.4-10.7 mg/kg and pheophytin between 2.2-6.5 mg/kg).

Across all sites in this round of sampling pheophytin *a* exceeded chlorophyll *a,* which may indicate the sediment pigment pool is dominated by degraded algal material rather than fresh microphytobenthic biomass.

Spatially, chlorophyll *a* concentrations were relatively consistent across the project sites (Discharge to S-40), with slightly elevated values observed at S-10, E-20 and N-10, while lower concentrations were recorded at W-20 and N-40. A similar spatial pattern was observed for pheophytin *a*, which showed strong correspondence with chlorophyll *a* across all sites. This indicates a consistent relationship between algal biomass and algal degradation products.

Consistent with the 2021 results, the 2026 dataset shows strong coupling between chlorophyll a and pheophytin a concentrations, indicating that increases in algal biomass are accompanied by proportional accumulation of degradation products. There was no clear evidence of anomalously high chlorophyll *a* concentrations indicative of localised eutrophic enrichment was observed at the

2026 sampling sites, and are broadly within a similar range of the Waikopua estuary sites sampled in 2021.

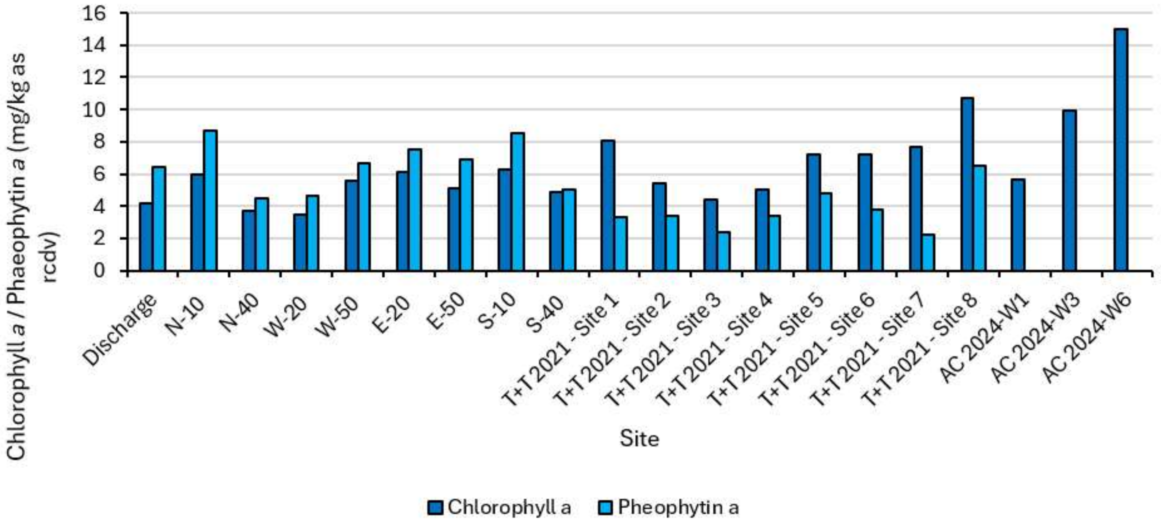

Figure 4.7 Chlorophyll a and Pheophytin a concentrations in sediment samples collected from around the discharge and from previous sampling at eight estuary sites in February 2021. Results are presented alongside AC Waikopua Monitoring sites which were most recently sampled in 2024.

4.2.2.4 Sediment particle size

Sediment grain size is a key determinant of benthic habitat characteristics and strongly influences the composition and distribution of benthic communities, making it an important parameter for interpreting ecological monitoring results.

Grain size analysis indicates that sediments at all sites are predominantly composed of very fine sand, silt and clay, with no coarse sand or very coarse sand present in any samples, and only minimal (<0.3%) medium sand at N-10, N-40 and E-50. Very fine sand was the dominant fraction of sediments at all sites (30.44-35.98%), while total mud content (classes <63µm) slightly exceeded the sand content across the sites (50.74-56.96%). Spatial variation is minimal, with N-10 showing the highest sand content and lowest mud proportion, whereas E-20 is comparatively finer grained with slightly higher clay and mud content (Figure 4.8). Overall, the sediment characteristics are indicative of a muddy depositional environment.

A number of sites within Waikopua estuary have been monitored for sediment quality and benthic health by Auckland Council since August 2004. Originally 10 sites were monitored annually, which was reduced to four sites in 2014 to enable sites to be sampled six-monthly. Waikopua estuary monitoring sites have displayed trends consistent with increased sedimentation since monitoring began including increased percentages of very fine sands/mud and decreasing number of taxa identified in fauna samples.

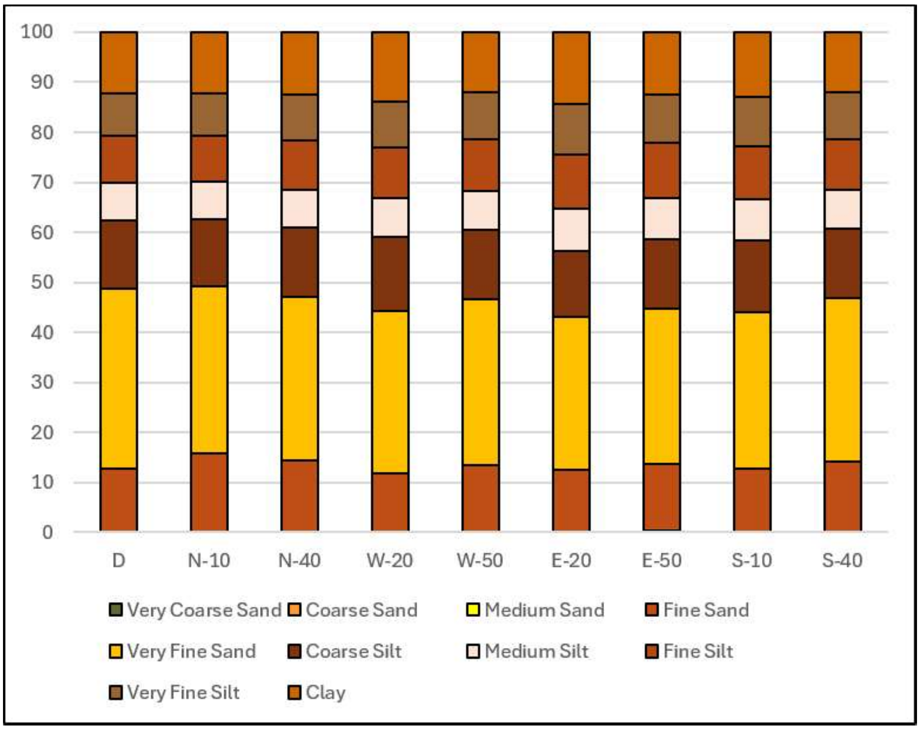

Figure 4.8 Grain size class percentages across each sampling site

4.2.3 Water quality

To inform the coastal modelling study, a review of background water quality was undertaken; the full details are included in Section 2.4 of that report (T+T, 2026), with key points of relevance to ecology summarised here.

Relevant water quality guidelines were considered for the model, including the Auckland Council marine water quality monitoring guidelines (Foley et al., 2018), which are derived from the Australian and New Zealand Environment and Conservation Council ('ANZECC') guidelines for fresh and marine water quality (ANZECC, 2000) alongside measured data from the Auckland region. Guideline values from Stevens et al. (2024) were also considered for comparison, with the adopted guideline values and source specified in Table 4.5 below.

The measurements from Foley et al. (2018) at the mouth of the Turanga Estuary (refer to Figure 4.9) from 2009 to 2015 were used to estimate background concentrations of water quality constituents within the Whitford Embayment (Table 4.5). The results indicate that background concentrations of TN, TP and TSS are close to guideline concentrations.

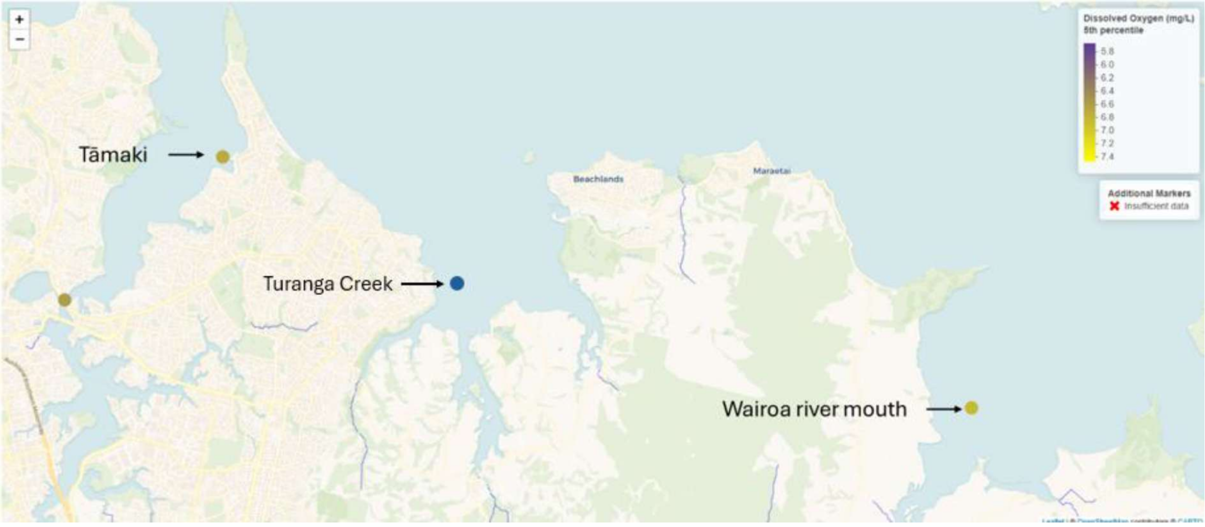

Figure 4.9: Auckland Council coastal water qaulity monitoring locations near the Whitford Embayment; Tāmaki and Wairoa river mouth, showing the 5th percentile dissolved oxygen. Turanga Creek site included for location reference (1774464 m E, 5914091 m N, NZTM).

Table 4.5: Summary of discharge concentrations, taken from T+T (2026). Background concentrations derived from Foley et al., (2018) monthly water quality monitoring at Turanga Creek.

Water quality constituent	Guideline concentration	Background concentration (C_b)	Total concentration at 100 m from the source (C_T)*	Difference in concentration $(C_T - C_b)$	Laboratory detection limits (Foley et al., 2018)	Variable
TN (mg/L)	0.11	~0.10	0.105	0.005	0.02	80th percentile
TP (mg/L)	0.032	~0.030	0.033	0.003	0.005	80th percentile
TSS (mg/L)	16	~15	14.987	-0.004	0.2	80th percentile
Faecal Coliform (CFU/100 mL)	14	5.0	4.996	-0.004	-	50th percentile

Note: TN, TP and TSS guidelines concentrations derived from Foley et al., (2018). Faecal coliform guideline concentrations derived from MfE (2003)

Dissolved oxygen is a fundamental indicator of aquatic ecosystem health because adequate levels are essential for the survival, growth, and reproduction of marine life, including fish and benthic invertebrates. If the dissolved oxygen drops below 5.0 mg/L or 90% oxygen saturation, the water quality is considered poor (Stevens et al., 2024, Foley et al., 2018).

Dissolved oxygen concentrations recorded between 2010 and 2025 ranged from 6.6–8.6 mg/L (5th–95th percentile) at Tāmaki and 6.7–8.9 mg/L at the Wairoa River mouth (no current DO measurements at Turanga Creek). When corrected for variations in temperature and salinity, dissolved oxygen saturation ranged from 88.8–102% and 93.4–105%, respectively. Median saturation values were close to atmospheric equilibrium (97–99%), indicating generally well-oxygenated conditions. Occasional supersaturation (>100%) is likely attributable to daytime photosynthetic activity. The 5th percentile saturation remains close to 90%. This suggests a receiving environment with a relatively high oxygen status and limited evidence of chronic oxygen depletion.

Faecal Indicator Bacteria (enterococci and faecal coliforms) sample records undertaken by Auckland Council from 2009 – 2015 in Turanga Creek (Foley et al., 2018) indicated:

- Enterococci typical values less than 50 CFU, exceeding 'red' safe swimming limits on one occasion in 2010.
- Faecal coliform 50th percentile values of 5 CFU, occassionally becoming much higher on an episodic basis.

More recent measurements of enterococci levels from Sunkist Bay immediately east of the Whitford Embayment are shown in Figure 4.10, as provided by Safe Swim (2026). Measured levels appear to exceed the 240 CFU/100 mL limit for safe swimming on an increasing basis over the duration of monitoring.

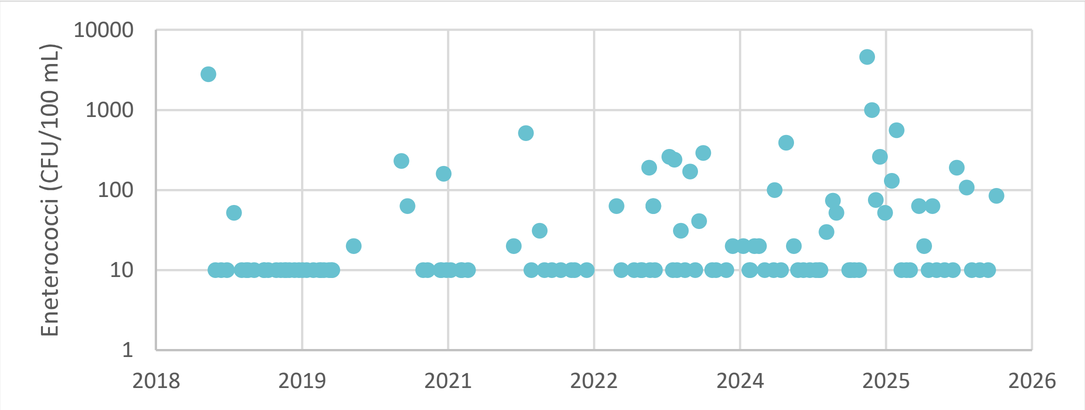

Figure 4.10:Measured enterococci levels at Sunkist Bay. Source: SafeSwim (2026).

4.2.4 Marine biosecurity

No marine biosecurity species are recorded within the Marine Biosecurity Porthole within the location of the proposed wastewater discharge. However, the benthic infauna results detected the invasive species *Theora lubrica* within all samples with abundance between five to 28 individuals per core. *T.lubrica* arrived in 1972 and is common in most ports around New Zealand and rapidly colonises disturbed and muddy habitats, although has a tolerance range of up to 50% mud. A very mud, pollutant and organic enrichment tolerant species, it is known to be an indicator species with which to assess organic enrichments and changes in the input of sediment and pollutants into estuaries (WRC, 2025).

Other species potential present include *S.spallanzanii*, as observed a drop camera image capture (Photograph 4.6). *S.spallanzanii* are an 'unwanted organism' and a notifiable pest under the Biosecurity Act (1993).

4.2.5 Summary of subtidal marine habitat values

Sections 4.2.1 to 4.2.4 outline the features and characteristics of the subtidal benthic habitats that are required to determine on the ecological value of the benthic habitat at the proposed ocean outfall location. This value is also determined based on the characteristics outlined in Appendix A Table 2, with an overall value determined on balance across the following characteristics:

- There were no observed exceedances above the ERC green or DGV / GV-High guidelines for heavy metals or PAHs at any site.

- Measured nutrients in sediment indicate ‘good’ or ‘very good’ ecological quality status with no indication of localised nutrient enrichment.
- Sediment particle size analysis demonstrate sediments typically comprise less than < 60% silt and clay grain sizes.
- The benthic invertebrate community has moderate species richness, diversity and abundance for the habitat type.
- The physical habitat has been largely unmodified, other than anthropogenic inputs (sediment) from catchment sources.
- Background water quality is close to guideline concentrations for TP, TN and TSS, indicating ‘fair’ to ‘poor’ water quality conditions.
- Invasive, opportunistic and/or disturbance tolerant species are at least present, and in some cased dominant (i.e. *theora lubrica*) at some of the sites sampled.
- No Threatened ecosystems or Threatened or At Risk marine invertebrates are known to be present.

On balance, and with reference to the attributes outlined in Appendix A Table 2, the subtidal benthic habitat within the location of the proposed ocean outfall has been assigned a **moderate** ecological value.

4.2.6 Subtidal seagrass

Approximately 78.1 ha of intertidal and subtidal seagrass beds are present in Waikopua estuary. Seagrass cover within the intertidal zone is not continuous but is present in patches across the mid-low intertidal areas, as observed during site survey and from aerial imagery.

Substrate around seagrass beds tends to be softer than surrounding areas due to the accumulation of fine sand and silt amongst the root systems. The most common organisms found in seagrass beds are crustaceans including mud crabs (*Helice crassa*, *Hemigrapsus crenulatus* and *Macrophthalmus hirtipes*) and shrimps, as well as small snails and sometimes bubble shells (e.g. *Haminoea zelandiae*). Infauna living beneath seagrass beds are typically wedge shells (*Macomona liliana*) and cockles (*Austrovenus stutchburyi*).

The extent of seagrass beds in Auckland and nationwide have rapidly declined since and continue to be threatened due to anthropogenic impacts such as sedimentation influencing water clarity and quality. During the 1950-60s, seagrass in the Auckland region experienced a massive die-off; this has been attributed to numerous factors including effects from the marine pathogen *Labyrinthula* (associated with the seagrass wasting disease), likely compounded by worsening sedimentation and water quality impacts associated with land-based development. This is reflected in the National Threat Status for seagrass, which is ‘At Risk – Declining’, noting that this is more stringent than the regional threat status of ‘Regionally – Not Threatened’ (de Lange et al. 2023 and Simpkins et al, 2025 respectively).

Historic aerials show that seagrass has been absent in the Whitford Embayment for more than 60 years. While it can be difficult to determine seagrass extent from aerials alone[6], more recent aerials as viewed on Auckland Councils GeoMaps viewer indicate an increase in the cover of seagrass habitat in the embayment, indicating that this habitat type is currently in a period of recovery.

[6] Dependent on image quality and the stage of the tidal cycle during which imagery is captured.

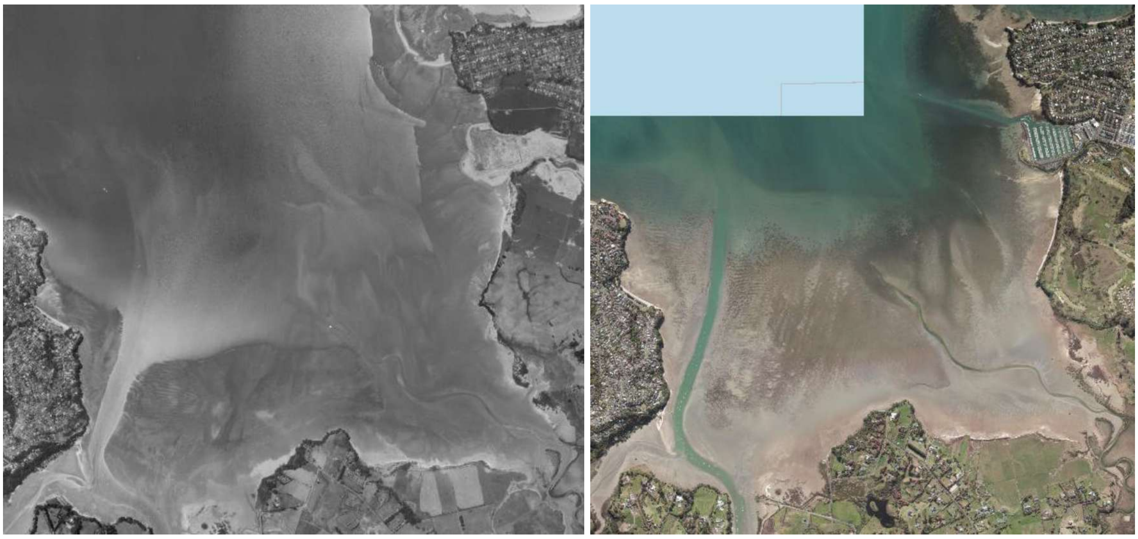

Figure 4.11: Whitford Embayment in the 1980s (left) with no seagrass present and 2024 / 2025 aerial imagery (right) showing seagrass extent (dark patches across the intertidal and subtidal). Aerial imagery sourced from Auckland Council GeoMaps.

4.3 Fish

The Whitford Embayment, including Waikopua, Mangemangeroa and Turanga Creeks provide important habitat for fish species, including shelter and nursery grounds. The Whitford Embayment is within the normal range of a number of marine species, these are presented in Appendix E (NABIS, 2021).

The Whitford Embayment is a hotspot for the hammerhead shark (*Sphyrna zygaena*) and yellow belly flounder (*Rhombosolea leporina*). The Whitford embayment is also a hotspot for juvenile yellow-eyed mullet (*Aldrichetta forsteri*). The wider Hauraki Gulf (2 km from the Site) is a hotspot for thresher sharks (*Alopias vulpinus*) and spawning hotspot for blue mackerel (*Scomber australasicus*) and horse mackerel (*Trachurus novaezelandiae*).

White pointer sharks (*Carcharodon carcharias*) also known as great white sharks utilise the Whitford Embayment and are Threatened – Nationally Endangered (Duffy *et al*., 2016).

The three creeks (Waikopua, Mangemangeroa and Turanga) also provide a pathway for migrating freshwater fish that are migrating either upstream to freshwater catchments, or downstream for spawning purposes.

4.4 Seabirds

Seabirds potentially present within the footprint of the ocean outfall structure and ZOI of the treated wastewater discharge are outlined below. Wading bird species (i.e. those likely to be found foraging on intertidal flats are listed in the EcIA lodged with the PPC88 application) are not described, given they do not utilise the subtidal.

In the context of this report, seabirds are defined as birds that spend some part of their lifecycle feeding at sea either in inshore or offshore waters. They are highly specialised and come to shore only to breed (Gaskin and Rayner, 2017).

The Hauraki Gulf is considered to be a national hotspot for seabirds, due to seabird diversity, together with the combination of multiple predator free breeding sites on islands and (increasingly) on the mainland with productive waters close to colonies (Gaskin and Rayner, 2017). There are 27 taxa known to breed in the wider Hauraki Gulf of which 16 are New Zealand endemic.

Of the species known to be present in the Hauraki Gulf, five are Threatened and 18 are At Risk (Robertson et al., 2021). A full list of seabirds potentially present in the Hauraki Gulf, and therefore potentially present in the Whitford Embayment and their associated threat status are included in Appendix D.

The potential for effects on seabirds is linked to their use of habitat within the ZOI, therefore key points on seabird use of the Hauraki Gulf waters (inshore and offshore) are outlined here:

- Approximately 60 % of NZ seabirds regularly forage more than 50 km offshore, while the remaining species feed over inshore waters.
- Gulls, shags, terns, penguins and gannets feed close to shorelines of the mainland and inner and outer Gulf islands, close to where they breed.
- Foraging ecology of seabirds in the Hauraki Gulf is linked to prey species (such as zooplankton, krill, fish) and the habitats utilised (i.e. open water versus estuaries).
- Boil or work ups are observed in inshore waters, linked to fish schools, where a variety of seabirds congregate to feed alongside marine mammals.
- The numbers of resident species, such as gulls, terns and shag species, can vary between breeding and non-breeding season.

There are no kororā records within the ZOI of the Project, with the closest iNaturalist records identifying dead kororā only. There are no iNaturalist records of breeding sites within the Whitford Embayment, but it is possible that penguins utilise the open water in the embayment for foraging or transiting between burrows and the open ocean.

4.5 Marine mammals

Marine mammals encompass cetaceans (whales and dolphins) and pinnipeds (seals and sea lions). Half the world’s cetacean species are found within New Zealand (Mulcahy and Peart, 2012), with the Hauraki Gulf considered to be a highly productive marine ecosystem important for a range of cetacean species (Dwyer, 2014).

A diverse assemblage of marine mammals have been sighted and recorded within the Hauraki Gulf including Orca (*Orcinus orca*) (O’Callaghan and Baker, 2002), pilot whales (*Globicephala melas*) (O’Callaghan and Baker, 2002), Arnoux’s beaked whales (*Berardius arnouxii*) (O’Callaghan and Baker, 2002), southern right whales (*Eubalaena australis*) (Carroll et al, 2014, Dwyer, 2014), common dolphins (Stockin et al., 2008a), bottlenose dolphin (*Tursiops trancatus*) (Constantine, 2002), Bryde’s whale (*Balaenoptera.brydei* and *B.edeni*) (Baker and Madon, 2007; Wiseman et al., 2011).

The Department of Conservation (DOC) marine mammals sighting database was reviewed to understand potential distribution of marine mammals in the Hauraki Gulf Marine Park, and that could be potentially present in the ZOI of the proposed ocean outfall. A nominal line was drawn from Whangaparaoa directly East to the Coromandel to capture marine mammal sightings within the inner Hauraki Gulf and that therefore could be present in the vicinity of the Whitford Embayment.

Of the 19 species identified from the DOC marine mammal sightings database, five are listed as ‘Data deficient’, four as ‘Threatened’ and three as ‘At Risk’ (Baker et al., 2019). A full list of marine mammals and their associated threat status is provided in Appendix F.

The potential for effects on marine mammals is linked to their use of habitat within the ZOI, therefore key points on marine mammal use of the Hauraki Gulf are outlined here:

- Resident populations, such as Bryde’s whales and common dolphins, are present in the Hauraki Gulf year-round. In particular, the Hauraki Gulf is important habitat for Bryde’s whales, being only one of three places in the world where this species resides year-round.

Bryde's whales are most frequently seen in the area between Kawau Island, Waiheke and Aotea where they spend around 90 % of their time in surface waters resting and feeding.

- Migratory populations, such as humpback whales, utilise the nutrient rich waters on a seasonal basis as they migrate between breeding and foraging grounds. Larger whale species are considered unlikely to be present in the shallow water of the Whitford embayment.
- Fur seals, as the most common pinniped in the HGMP, utilise the waters, islands and rocky coastlines for resting, breeding, nursing and foraging.

4.6 Summary of marine ecological values

A summary of the ecological values that will be included in the assessment in Section 5 are included in Table 4.6. These values relate to subtidal habitats and species and are in addition to values described in the PPC88 Marine EcIA in Appendix F.

Table 4.6: Summary of ecological values within the project ZOI and surrounding Whitford Embayment

Habitat / species	Ecological value
Marine habitats	Subtidal sandy / muddy substrate **Moderate** based on sediment and water quality, benthic infauna abundance and diversity, level of habitat modification.
	Subtidal / intertidal seagrass **High** based on Threat status – At Risk Declining (De Lange, 2023)
Seabirds	Due to the identification of the Hauraki Gulf as a nationally significant hotspot for seabirds, with a diverse species assemblage (with Threatened and At Risk species), proximity to island and mainland breeding sites and foraging capacity in productive waters, the ecological value of seabirds potentially present in the ZOI and Whitford Embayment is **very high**. With reference to the EIANZ EcIAG framework (Appendix A Table 1), the ecological value of kororā is **very high** given their national threat classification of 'At Risk – Declining' and regional threat classification of 'Regionally Vulnerable' (Robertson et al. 2021 and Wooly et al., 2024 respectively).
Fish	Based on the potential high diversity and abundance of fish species, and the habitat available within Waikopua Creek and the wider Whitford embayment, the values in the marine receiving environment are considered **high** for fish.
Marine mammals	Based on potential species diversity and abundance (with Threatened and At Risk species present in the inner Hauraki Gulf), resident populations and foraging potential in the Hauraki Gulf, the ecological value of marine mammals potentially present in the ZOI and Whitford Embayment is **very high**.

5 Assessment of ecological effects

This section outlines the potential effects on the ecological features and values discussed above and in the PPC88 Marine EcIA (T+T, 2022) and provides a conclusion as to whether effects can be managed to be low or very low (as outlined in the matrix shown in Appendix A Table 4) or whether further residual effects management is required.

- Section 5.1 summarises the expected effects to marine ecological values associated with development of the live zone and construction and operation of the wastewater discharge.
- Section 5.1.1 outlines the proposed measures to avoid, remedy or minimise potential effects associated with the activity.
- Sections 5.2.1 to 5.2.3 summarise the values and overall level of effect to marine ecological values that were outlined during PPC88 (earthworks, stormwater discharges and disturbance effects) and that are found in Appendix F.
- Section 5.2.4 outlines the full assessment of effects associated with the construction and operation of the ocean outfall and treated wastewater discharge.

5.1 Summary of actual and potential ecological effects

The proposed activities have been assessed to have the following potential effects on marine ecological values:

- Construction phase disturbance effects to subtidal benthic habitat associated with directional drilling of the wastewater pipe in the CMA and constructing a permanent diffuser pipe structure on the seafloor, including potential underwater acoustic effects. Installation of the diffuser pipe has been proposed via two methodologies; coffer dam installation or via a marine based installation utilising barges and divers.
- Permanent occupation of the seabed by the wastewater diffuser pipe, with soft sediment substrate permanently changed to hard substrate over an area of approximately 20 m^2.
- Increased contaminant loading to the water column from the treated wastewater discharge that has the potential to impact on benthic organisms, seabirds, fish and marine mammals.
- Increased nutrient enrichment of benthic sediments associated with the wastewater discharge that has flow on effects up the food chain from benthic organisms to fish, coastal avifauna and marine mammals and potential for nuisance plant growths (including macroalgae and phytoplankton).
- Effects to seagrass habitat quality and extent in the Whitford Embayment associated with increased nutrient loading.
- Effects to marine fauna associated with Emerging Organic Contaminants (EOCs) found in wastewater.
- Construction phase earthworks effects as outlined in the PPC88 application and PPC88 Marine EcIA, including increased suspended and deposited sediment that has the potential to impact on marine invertebrates, birds and fish.
- Stormwater discharge related effects as outlined in the PPC88 application and PPC88 Marine EcIA, including increased contaminant loading to the CMA with potential impacts on marine invertebrates, birds and fish.
- Improved access to the coastal environment and the coastal walkway, as outlined in the PPC88 application and PPC88 Marine EcIA, resulting in increased levels of disturbance to significant and / or sensitive habitats and increased disturbance to coastal avifauna due to increased presence of people, pets (dogs and cats) and pest animals.

5.1.1 Proposed effects management

Adverse effects on marine ecology associated with the proposed development of the live zone and operation of the CW WWTP are proposed to be avoided, remedied or mitigated via the following management measures:

- Considerable work has been undertaken to date to identify methodologies to avoid potential effects to marine ecology values associated with the wastewater discharge. Multiple modelling scenarios have been run to simulate the potential effects associated with a treated wastewater discharge at locations in the Whitford Embayment, including:
  - Discharge direct to site watercourses.
  - Discharge direct to the CMA within Waikopua Creek at two locations.
  - Discharge direct to the CMA at a location outside of Marine-SEAs and subtidal seagrass bed (the option carried forward into this application).
  - Detaining or not detaining discharges, with detained discharges to be released on high, outgoing tides.
- Implementation of Erosion and Sediment Control (ESC) during construction phases on site, as outlined in the Precinct Provisions and the PPC88 Marine EcIA.
- Stormwater treatment on site in line with GD01 and as outlined in Precinct Provisions and the PPC88 Marine EcIA.
- Designing the coastal walkway alignment to avoid sensitive coastal areas, pest control and coastal buffer enrichment planting to minimise disturbance and provide additional protective habitat for coastal avifauna.
- As outlined in the Raath and Associates report (2026a), the CW WWTP treatment train process provides a modular and scalable approach to treatment of wastewater inflows with high removal efficiencies and discharged wastewater treatment to a high standard.
- Treated effluent to pass through an oxygen nanobubble polishing system immediately upstream of the ocean outfall to reduce the likelihood of localised anaerobic conditions developing around the diffuser pipe.
- As outlined in the underwater acoustics assessment (Hegley Acoustic Consultants, 2026), mitigation measures such as soft starts, dampening and visual observations for marine fauna will be undertaken prior to coffer dam piling works, with final details to be determined based on the selected construction method.
- A routine marine monitoring programme commencing prior to the discharge coming online to establish a baseline, with regular routine monitoring commencing thereafter. A Marine Monitoring Plan (MMP) will be developed that includes:
  - Routine monitoring requirements to monitor benthic ecology, sediment and water quality in the vicinity of the proposed wastewater outfall.
  - Monitoring of potential effects to subtidal and intertidal seagrass extent and quality in the Whitford embayment that can be attributed to effects from nutrient enrichment.
  - An adaptive monitoring approach that allows for the future inclusion of EOC monitoring subject to the development of national guidance and changes to monitoring frequency and / or scale depending on observed effects.
  - The process required to determine sampling frequencies and review of the MMP.

5.1.2 Zone of Influence

The ZOI is defined for the purposes of the assessment as the habitats, species and marine areas that could potentially be impacted by the project works.

The determination of the ZOI for the proposed wastewater discharge to the CMA is based on the coastal modelling outputs described in T+T (2026) and summarised in Section 3. As described, modelled concentrations for the various pollutants are provided at the boundary of a mixing zone 100 m in radius encircling the discharge location using the highest concentration modelled.

The outputs indicate that the highest modelled discharge concentrations (dry weather conditions, neap tides and low-water slack tide) are diluted by 850-fold (80th percentile) at the extent of the 100 m mixing zone.

These results indicate that the actual ZOI is likely to be significantly smaller than 100 m radius of the discharge and is likely localised to within the immediate vicinity (i.e. tens of meters) of the discharge location.

5.2 Magnitude and overall ecological effect

5.2.1 Construction phase earthworks

Effects to marine ecology associated with construction phase earthworks have been described in the PPC88 Marine EcIA (Appendix F) submitted as part of the PPC88 application and are summarised here for completeness:

- The EcIA outlined a fieldwork programme and desktop analysis undertaken to describe the ecological values of coastal habitats, coastal saline vegetation, fish and coastal avifauna that are present predominantly in the intertidal area of the Whitford Embayment adjacent to the Site.
  - Marine habitats were described as having values ranging from low (rock revetment) to high or very high for seagrass, firm muddy sand flats / cockle shell covered flats, shellbanks and sandstone reef.
  - Fish were described as having a high ecological value due to the potential species assemblage and diversity.
  - Mangroves and saltmarsh / saltmeadow were described as having moderate and high ecological value respectively based on habitat provisions.
  - Coastal birds were described as having low to very high ecological value depending on the species and associated threat status, and the relevant functional groups (i.e. waders, water column feeders, generalist feeders and coastal fringe and wetland species).
- An assessment of potential effects to these values was undertaken using the outputs from coastal modelling to understand the fate of sediment generated during earthworks in the CMA, including sediment deposition and suspension in the water column.
- Potential effects to these values associated with construction phase earthworks include:
  - Increased suspended sediment due to construction related discharges that have the potential to impact on marine invertebrates, birds and fish.
  - Increased sedimentation (suspended and deposited) which can impact on benthic habitat quality, invertebrates (including shellfish), birds and can result in increased mangrove encroachment.
- The EcIA determined that, combined with effects associated with ongoing stormwater discharge (described below), that most effects associated with enabling development of the Live Zoned land could be managed to be **very low** to **low**, provided measures to avoid, remedy or minimise effects were implemented as outlined in the report, and that have since been carried through into Precinct Provisions.

- Precinct provisions require effects management to minimise sediment runoff and manage discharge effects on the receiving environment, including maximum disturbance areas, staged earthworks and erosion and sediment controls.
- Notwithstanding all efforts to manage effects, there were residual adverse effects of moderate or higher to firm muddy sand flats / cockle shell covered flats, shellbank habitats and coastal avifauna that needed to be addressed via additional effects management.
- The proposed approach to residual effects management was outlined in the EcIA (Section 6), in line with current best practice, and identified the need for additional enhancements that should be guided by the application of a Biodiversity Compensation Model (BCM) and outlined in a Coastal Bird Management Plan (CBMP). The requirements for a CBMP are also outlined in Precinct Provisions and Appendix G. Residual effects management is discussed further in Section 6.

5.2.2 Stormwater discharges

Effects to marine ecology associated with ongoing stormwater discharges have been described in the PPC88 Marine EcIA (Appendix F) submitted as part of the PPC88 application and are summarised here for completeness:

- The EcIA outlined ecological values as described in Section 5.2.1 above.
- An assessment of potential effects to these values was undertaken using the outputs from coastal modelling to understand the fate of stormwater contaminants generated from ongoing stormwater discharging to the CMA.
- Potential effects to these values associated with ongoing stormwater discharges include increased contaminant loads due to stormwater contaminants that have the potential to impact on marine, invertebrates, birds and fish.
- The EcIA determined that, combined with effects associated with construction phase earthworks (described above), that most effects associated with enabling development of the Lived Zone could be managed to be **very low** to **low**, provided measures to avoid, remedy or minimise effects were implemented as outlined in the report, and that have since been carried through into Precinct Provisions.
- Precinct provisions require effects management to contribute to improvements to water quality and stream health, including provisions to treat stormwater runoff in accordance with Guidance Document 2017/001 Stormwater Management Devices in the Auckland Region (GD01).
- As mentioned above, notwithstanding effects management measures, there were residual adverse effects of moderate or higher to firm muddy sand flats / cockle shell covered flats, shellbank habitats and coastal avifauna.
- An approach to residual effects management was developed, as outline above and repeated in Section 6 below.

5.2.3 Disturbance effects to sensitive habitats and coastal avifauna

Effects to marine ecology associated with disturbance to sensitive habitats and coastal avifauna in the CMA have been described in the PPC88 Marine EcIA (Appendix F) submitted as part of the PPC88 application and are summarised here for completeness:

- The EcIA outlined ecological values as described in Section 5.2.1 above.
- Potential effects to these values were described in view of improved access to the coastal environment and the coastal walkway resulting in increased levels of disturbance to significant

and / or sensitive habitats and increased disturbance to coastal avifauna due to the increased presence of people, pets and pest animals.

- The EcIA determined that most of these effects to marine ecological values could be managed to be **very low** to **low**, provided measures to avoid, remedy or minimise effects were implemented as outlined in the report, and that have since been carried through into Precinct Provisions.
- As mentioned above, notwithstanding effects management measures there were residual adverse effects of moderate or higher to firm muddy sand flats / cockle shell covered flats, shellbank habitats and coastal avifauna.
- Precinct Provisions require an application for subdivision in the precinct adjoining the CMA must be accompanied by a Coastal Bird Management Plan (CBMP), which addresses the potential effects and is further discussed in Section 6.

5.2.4 Effects of the subtidal wastewater discharge

5.2.4.1 Marine habitats

Potential adverse effects on marine habitat values (subtidal habitats and seagrass) in the marine receiving environment are those associated with both the physical construction and permanent occupation of the seabed by the wastewater diffuser pipe and the ongoing discharge of treated wastewater from the CW WWTP.

Construction phase effects are expected to be temporary (i.e. days to weeks) while the diffuser pipe is connected to the subsea pipeline. For the purposes of this assessment, we have assumed the installation method with the highest level of effect, being the installation of coffer dams, dewatering and affixing of the diffuser pipe to the seabed. The coffer dams and dewatered area is expected to be in the order of 150 m^2. It is likely that sessile benthic organisms in this area will be highly impacted or die-off during the dewatered period. The literature on disturbance of subtidal benthic habitats suggests that defaunation of an area can see the timeframe for natural restoration of species richness vary between a few months to three years (for complete restoration) (Lewis et al., 2001; Beukema et al., 1999).

There will be modification to approximately 20 m^2 of subtidal benthic habitat, which will inside be hard substrate associated with the diffuser pipe structure. The newly created structure will also provide habitat / substrate for colonisation by other fauna.

Should an alternative method be utilised (i.e. attachment via divers), the overall magnitude of effect is expected to be lower than that associated with temporary coffer damn installation and dewatering.

Treated wastewater discharges may contribute to increased loadings of nitrogen and phosphorus which can cause eutrophication in estuaries. Increases in TSS, microbial pathogens, heavy metals, and EOCs are also associated with wastewater discharges, however it is noted that these effects are significantly lower in scale compared with those expected as a result of nutrient enrichment.

Nutrient enrichment, including increases in algal and shoreline plant growths, organic loadings and enrichments, eutrophication and altered benthic habitat structure and functioning are the primary concern associated with discharge of treated wastewater to the marine receiving environment. A response to increased nutrient concentrations and loads will vary seasonally with less risk of adverse effects during autumn and winter, and higher risk because of warmer temperatures and higher light levels in spring and summer (James *et al*., 2016).

When considering the magnitude of effect on subtidal habitats, the following is noted:

- Construction phase effects are expected to be high in the short term (i.e. weeks), with the magnitude of effect expected to lessen to negligible once the construction phase is over and the site restabilises, with mobile fauna recolonising the area. The overall magnitude of effect takes into account this short-term effect and the length of time required for recolonisation.
- Ongoing, permanent effect associated with treated wastewater discharge are likely to be low within proximity (i.e. tens of meters) to the discharge point location based on coastal modelling and dilution factors. With reference to Appendix A Table 3, a low magnitude of effect equates to a minor shift away from existing baseline conditions, whereby the change arising from the alteration being discernible, but the underlying character, composition and/or attributes of the existing baseline condition remaining similar to pre-impact conditions.
- Wastewater treatment train processes and the addition of the nanobubble technology mitigate the potential effect associated with the wastewater discharge.
- Several layers of conservatism have been built into the coastal model, which help to offset uncertainty associated with relying on model outputs.

Based on the above we consider that the magnitude of effect on benthic habitat within the ZOI of the ocean outfall is **low**; based on the **moderate** ecological value of benthic habits this equates to an overall **low** level of ecological effect.

The run-off of nutrients and sediments into estuarine and coastal areas as a result of human activities on land is considered to represent the highest threat to seagrasses worldwide (Hemminga and Duarte 2000; Coles *et al*. 2003; Green and Short 2003; Walker 2003). Seagrass in the Whitford embayment has the potential to be impacted by an increase in nutrients associated with the treated wastewater discharge.

Many seagrasses respond favourably to low or moderate nitrogen or phosphorus enrichment (Turner and Schwarz, 2006). However, excessive nitrogen loading in the water column can inhibit seagrass growth and survival. For example, increases in nutrient loading can promote the growth of phytoplankton, epiphytic algae and bottom-living and free-floating macroalgae, all of which can contribute to light reduction to seagrass beds and inhibit seagrass growth (Turner and Schwarz, 2006).

When considering the magnitude of effect on seagrass habitats, the following is noted:

- There are no construction-based effects expected on seagrass habitats, given the distance of the proposed discharge location from existing subtidal seagrass beds.
- On an ongoing basis, the ZOI of the wastewater discharge is in the order of tens of meters and high contaminant concentrations are not expected to extend as far as subtidal seagrass beds. However, the discharge does increase the proportional load of nutrients entering the Whitford Embayment, therefore a marine monitoring programme that looks at seagrass extent and quality in the vicinity of the discharge (intertidal and subtidal) will provide more confidence that the discharge is not adversely impacting seagrass habitat.
- Notwithstanding the treatment process and anticipated removal efficiencies, there are potential effects to seagrass associated with EOCs that will not be fully understood until national or regional guidance is provided and an appropriate monitoring programme can be implemented (refer to more detail on EOCs in Section 5.2.4.2 below). On this basis, a conservative approach is recommended via the adaptive monitoring programme previously described Section 5.1.1 above.

Based on the above the magnitude of the effect of the discharge on seagrass habitat is expected to be **negligible**; based on the **high** ecological value of seagrass habits this equates to an overall **very low** level of ecological effect.

5.2.4.2 Fish

Potential adverse effects on fish species in the marine receiving environment include effects on food resources and risk of predation, avoidance and displacement due to reductions in water clarity and other water and sediment quality related parameters including oxygen depletion and changes in water chemistry associate with algal blooms.

Rays in particular feed primarily on benthic bony fishes and invertebrates such as molluscs, worms and crustaceans, by repeatedly inhaling sediments and water through the mouth and venting this out through gill slits, an excavatory feeding mechanism which has a bioturbation effect (Cadwallader, 2020). Speckled sole and other flatfish also feed directly on the benthos. In this regard, any adverse impacts on benthic fauna assemblages (outlined above) are likely to impact available food resources for fish, and contaminants could be passed on up the food chain and carried outside the immediate marine receiving environment when fish move away.

The Whitford Embayment is also likely to provide a migration pathway for diadromous fish species[7] via the Waikōpua, Tūranga and Mangemangeroa Creeks, that are either migrating upstream to freshwater habitats or downstream for spawning.

Potential adverse effects to fish are also anticipated from EOCs. EOCs are trace compounds found in wastewater and may include pharmaceuticals and personal care products (PPCPs), endocrine disrupting compounds (EDCs), household cleaning products and microplastics, to name a few. These compounds are typically present at extremely low concentrations (Raath and Associates, 2026b). While in the early stages of research, the potential impacts of EOCs on marine life include reduced feeding rates, survival, binding of mussels to rock surfaces, changes to spawning behaviour and immune response and biochemical markers (Gaw *et al*., 2014). At the time of writing, there are no regional or national guidelines outlining appropriate ecological thresholds for individual EOCs, although national monitoring frameworks are actively being developed. This is in part due to the large number of potential EOCs, associated laboratory costs to test for individual EOCs and the need to test across both freshwater and marine domains for a wide range of organisms.

Raath and Associates (2026b) outline the performance capabilities of the CW WWTP with regard to anticipated removal of EOCs. While a specific removal efficiency is not provided, the following is noted:

- The combined works process differs from conventional activated sludge systems through operation with extended sludge age and long biomass retention times, which are recognised internationally as important factors in the degradation of slowly biodegradable organic compounds.
- The biofilm environment in the CW process supports a highly diverse microbial population that are capable of degrading more complex molecules.
- The combination of aerobic oxidation and denitrification provides multiple opportunities for EOC removal throughout the treatment process.
- Many EOCs exhibit an affinity for biological solids and are therefore removed via clarification and sludge wasting processes (including microplastics).
- The final UV disinfection stage acts as a supplementary polishing step immediately prior to discharge.

The Raath and Associates report notes that the removal efficiency of individual EOCs is highly compound specific and dependent on several variables, however international studies support

[7] Fish species that live in both freshwater and marine environments for a portion of their life cycle.

substantial reductions in EOCs via the same processes employed by the proposed CW WWTP (Raath and Associates, 2026b).

The report also notes that while compound specific removal rates would require targeted monitoring, the proposed treatment approach represents a higher level of treatment than conventional secondary wastewater treatment systems.

There is a temporary potential adverse effect to fish species associated with the construction of the permanent wastewater diffuser pipe on the seabed, with construction expected to be undertaken via divers or via coffer dams to create a dry working environment and exclusion of the seabed from the influence of the tide. As with marine habitats, we have assessed the installation method with the highest potential impact to ecology, being the installation of the coffer dam and dewatering.

During construction (which is expected to be temporary (i.e. days to weeks/months)), fish species could be impacted via underwater noise associated with installation of coffer dams. Mitigation measures to address this are outlined in the underwater acoustics report (Hegley Acoustic Consultants, 2026) and include soft starts and dampeners. Fish are expected to self-relocate away from the area once activities commence due to localised disturbance.

When considering the magnitude of effect on fish, the following is noted:

- Construction effects are expected to be temporary (i.e. days to weeks/months) and are based on the installation method with the highest potential impact to fish species.
- Construction impacts occur within an area of approximately 150 m^2, which is considered within the context of habitat availability within the wider embayment (>11,500,000 m^2 at high tide).
- The ZOI of the wastewater discharge (i.e. the area within which wastewater contaminant concentrations are elevated compared to background concentrations) is assessed as being in the order of tens of meters from the discharge point. Spatially, it is not expected that this effect would fundamentally alter the extent of available habitat for fish in the Whitford Embayment, either for feeding, breeding, or to maintain migration pathways up tidal creeks.
- Based on an overall **low** magnitude of effect on benthic communities, it is likely that there will be some effect on fish species that feed directly on the benthos within the ZOI.
- Notwithstanding the treatment process and anticipated removal efficiencies, there are potential effects associated with EOCs that will not be fully understood until national or regional guidance is provided and an appropriate monitoring programme can be implemented. On this basis, a conservative approach is recommended via the adaptive monitoring programme previously described Section 5.1.1 above.
- As outlined in the underwater acoustics assessment (Hegley Acoustic Consultants, 2026), mitigation measures such as soft starts, dampening and visual observations for marine fauna will be undertaken, with final details to be determined based on the selected construction method.

With reference to the above we consider that the magnitude of effect on fish within the ZOI of the ocean outfall will be **negligible**; based on the **high** ecological value of fish this equates to an overall **very low** level of ecological effect.

5.2.4.3 Seabirds

Potential adverse effects on seabird species in the marine receiving environment centre around the permanent changes in water quality, such as elevated nutrient levels and associated algal growth, and reduced water clarity that may affect the foraging success of visual predators. As indicated in Sections 5.2.4.1 and 0 above, potential effects to benthic infauna community composition and fish species may also alter the abundance or composition of fish and invertebrates that seabirds feed on.

The inherent uncertainties associated with EOCs, as described for fish in Section 5.2.4.2 are also applicable to seabirds.

During construction (which is expected to be temporary (i.e. days for the coffer dam and potentially months for the diffuser pipe installation), seabird species that could be impacted by both above and below water noise are expected to self-relocate away from the area once activities commence.

When considering the magnitude of effect on seabirds, the following is noted:

- Of the seabirds identified in the values section, it is noted that the Whitford Embayment is not recognised as being of special significance to those species during critical stages of their lifecycle (i.e. during breeding) and generally provides foraging habitat only.
- Construction effects are expected to be temporary (i.e. days to weeks/months) and are based on the installation method with the highest potential impact;
- Construction impacts occur within an area of approximately 150 m^2, which is presented within the context of habitat availability within the wider embayment (>11,500,000 m^2 at high tide) and the Inner Hauraki Gulf.
- The ZOI of the wastewater discharge (i.e. the area within which wastewater contaminant concentrations are elevated compared to background concentrations) is assessed as being in the order of tens of meters from the discharge point. Spatially, it is not expected that this effect would fundamentally alter the extent of available habitat for seabirds in the Whitford Embayment, either for feeding, or for resting on the surface.
- Based on a **low** magnitude of effect on benthic communities and a **low** magnitude of effect on fish, it is likely that there will be a flow on effect to seabird species that feed directly on the benthos and fish within the ZOI.
- Notwithstanding the treatment process and anticipated removal efficiencies, there are potential effects associated with EOCs that will not be fully understood until national or regional guidance is provided and an appropriate monitoring programme can be implemented. On this basis, a conservative approach is recommended via the adaptive monitoring programme previously described Section 5.1.1 above.
- The noise mitigation measures outlined by Hegley Acoustic Consultants (2026), although proposed for marine mammals, will also minimise effects to seabirds.

We consider that the magnitude of effect on seabirds within the ZOI of the ocean outfall will be negligible; combined with the **very high** ecological value of coastal avifauna this equates to an overall **low** level of ecological effect.

Kororā are assessed separately to seabirds, given the different characteristics of the species. Being flightless they are more susceptible to localised pressures and are less able to self-relocate away from an area of disturbance or poor water quality. They also have range restrictions around foraging distance from burrows, particularly during the breeding season. There were no records of breeding habitat in the Whitford Embayment, although this cannot be ruled out. However, given the large areas of intertidal habitat within the embayment, this would render large areas of the shoreline unsuitable for kororā burrows.

Potential effects to kororā are similar to those already described for seabirds. Kororā forage in the water column, therefore changes to water quality that impact clarity, and subsequently foraging success, can have detrimental effects on kororā. In addition to all of the points above (relating to the wastewater outfall construction and operation), when considering the magnitude of effect on kororā:

- Kororā that transit through the embayment can avoid areas of lower water quality in the immediate vicinity of the wastewater discharge. The ZOI is sufficiently small that it would not impede access to other areas of the embayment, should any of the shoreline be utilised for kororā burrows.

We consider that the magnitude of effect on kororā within the ZOI of the ocean outfall is negligible; based on the **very high** ecological value of kororā this equates to an overall **low** level of ecological effect.

5.2.4.4 Marine mammals

Potential adverse effects on marine mammals in the marine receiving environment centre around the permanent changes in water quality, such as elevated nutrient levels and associated algal growth, and reduced water clarity that may affect the foraging success of visual predators or require marine mammals to forage elsewhere. As indicated in Section 5.2.4.2 above, potential effects to fish species may also alter the abundance or composition of fish that marine mammals feed on; the potential magnitude of effect to fish was assessed as being negligible. The inherent uncertainties associated with EOCs, as described for fish in Section 5.2.4.2 are also applicable to marine mammals.

There is a temporary potential adverse effect to marine mammals associated with the construction of the permanent wastewater diffuser pipe on the seabed, as per construction methods previously described. As with marine habitats, we have assessed the installation method with the highest potential impact to ecology, being the installation of the coffer dam and dewatering.

During construction (which is expected to be temporary (i.e. days for the coffer dam and potentially months for the diffuser pipe installation), marine mammals that could be impacted by underwater noise are expected to self-relocate away from the area once activities commence. A potential underwater impact zone of 610 m in radius from the construction area has been identified in the underwater acoustics report (Hegley Acoustic Consultants, 2026). This zone is based on the worst-case construction scenario and for the most vulnerable marine mammal species (Very High Frequency hearing range). Within this zone, marine mammals may experience permanent hearing effects, therefore a marine mammal observer will be required to ensure mitigation measures are properly implemented and that marine mammals are not within this area once piling works commences (Hegley Acoustic Consultants, 2026). Further mitigation measures to address effects are outlined in the underwater acoustics report (Hegley Acoustic Consultants, 2026) and include soft starts and dampeners bubble curtains if appropriate.

When considering the magnitude of effect on marine mammals, the following is noted:

- A conservative approach to identification of potential species presence was adopted, using a nominal line drawn from Whangaparaoa directly East to the Coromandel to capture marine mammal sightings within the inner Hauraki Gulf. Although the Hauraki Gulf provides habitat for a wide range of marine mammals, it is unlikely that any of the species identified would be anything other than occasional visitors to the Whitford Embayment, using the available habitat for opportunistic feeding. This is particularly the case at low tide, as large areas of the embayment are intertidal.
- Construction effects are expected to be temporary (i.e. days to weeks/months) and are based on the installation method with the highest potential impact.
- Construction impacts occur within an area of approximately 150 m^2, which is presented within the context of habitat availability within the wider embayment (>11,500,000 m^2 at high tide) and the Inner Hauraki Gulf.
- The ZOI of the wastewater discharge (i.e. the area within which wastewater contaminant concentrations are elevated compared to background concentrations) is assessed as being in the order of tens of meters from the discharge point. Spatially, it is not expected that this effect would fundamentally alter the extent of available habitat for marine mammals in the Whitford Embayment for opportunistic feeding.

- Notwithstanding the treatment process and anticipated removal efficiencies, there are potential effects associated with EOCs that will not be fully understood until national or regional guidance is provided and an appropriate monitoring programme can be implemented. On this basis, a conservative approach is recommended via the adaptive monitoring programme previously described Section 5.1.1 above.
- The mitigation measures outlined by Hegley Acoustic Consultants (2026), provide guidance on standardised approaches to manage effects to marine mammals during the construction period and are considered best practice in New Zealand.

The magnitude of effect on marine mammals within the ZOI of the ocean outfall is expected to be **negligible**; based on the **very high** ecological value of marine mammals this equates to an overall **low** level of ecological effect.

6 Residual effects management

This section outlines the approach to address all effects to marine ecology values affected by the proposed development of the live zone. There are no residual effects associated with the installation and operation of the ocean outfall and treated wastewater discharge. This includes effects already discussed in the PPC88 Marine EcIA (i.e. where effects from PPC88 were identified as being moderate and above) on firm muddy sand flat / cockle shell covered flats, shellbank habitats and coastal birds.

With reference to the EIANZ framework, further effects management to reduce the overall effects on habitats and coastal avifauna was required to ensure NNL in biodiversity values.

The residual effects management approach, as set out in the PPC, seeks to achieve No Net Loss (NNL) outcomes for marine biodiversity through the type and magnitude of restoration and enhancement actions proposed. Accordingly, this section sets out:

- An overview of residual effects management, i.e. offsetting and compensation (Section 6.1).
- The overall approach for addressing the residual effects on marine ecological values that cannot be avoided, remedied or mitigated (Section 6.2).
- The proposed habitat restoration or enhancement measures that will be undertaken for the purpose of addressing residual effects on marine ecological values (Section 6.3).

6.1 Residual effects management principles

Management of residual effects after efforts to avoid, remedy or mitigate impacts fall to offsetting or compensation. As defined in Baber et al., (2021) and Quinn et al. (2021):

> *"A biodiversity offset is a 'measurable conservation outcome' that meets certain principles and balances adverse residual effects, to a No Net Loss (NNL) or preferably Net Gain (NG) standard. While offsetting requires a measurable outcome that has been quantified through a robust and transparent process, biodiversity compensation does not necessarily need to be quantified and measurable. However, compensation measures under the principles of biodiversity compensation (as described below) are intended to achieve No Net Loss or preferably Net Gain outcomes where possible."*

Key biodiversity offsetting principles as set out in Appendix 3 of the National Policy Statement for Indigenous Biodiversity (MfE, 2023) include the principles of:

- NNL or preferably NG outcomes.
- Adherence to the effects management hierarchy. Offset should only be contemplated after steps to avoid, remedy, or mitigate adverse effects have sequentially been exhausted, and thus applies only to residual biodiversity impacts. Compensation, as the least certain and most risky management of effects, should be considered as a last resort.
- Ecological Equivalence, meaning the degree to which the biodiversity gain attributable to an offset is balanced with the biodiversity losses and therefore whether the exchange achieves NNL.
- Additionality, meaning the gains in biodiversity must be above and beyond gains that would have occurred anyway in the absence of the offset or compensation.
- Long-term outcomes (preferably in perpetuity).
- Landscape context, whereby the biodiversity offset or compensations considers the landscape context of both the impact site and the offset site.

- Science and matauranga Māori, whereby the design and implementation of a biodiversity offset must be a documented process informed by science, including an appropriate consideration of matauranga Māori[8].

Similarly, key biodiversity compensation principles are outlined in Appendix 4 of the NPS-IB (MfE, 2023). These biodiversity compensation principles generally follow the above offsetting principles, with the most notable difference relating to the scale of biodiversity compensation. Instead of the NNL or preferably NG outcome required by offsetting, compensation requires the indigenous biodiversity values lost through the activity to be addressed by positive effects to indigenous biodiversity that outweigh the adverse effects.

6.2 Proposed approach to residual effects management

The proposed residual effects management approach seeks to achieve NNL outcomes within ten years of commencement of compensation actions for the residual effects on indigenous marine biodiversity values.

Currently, our understanding of potential residual effects is based on outputs from predictive models (for effects on sand flats and shell banks) and literature of disturbance-based effects on coastal birds. The approach to residual effects management will broadly seek to first monitor actual effects, and concurrently implement compensation actions that will have a clear and direct benefit to marine biodiversity values. Further monitoring of effects and adaptive management will direct the approach for further compensation actions if Biodiversity Compensation Modelling suggests that there is a NL of biodiversity.

Ecological compensation options are outlined in Section 6.3 and will be developed further and fine-tuned through the development of a Coastal Bird Management Plan and subsequently following monitoring and adaptive management as development proceeds.

The proposed habitat restoration and enhancement options are all forms of compensation and do not strictly meet the definition of offsetting. This is due to the nature of residual effects and their management, which do not readily lend themselves to accounting for gains and losses with the necessary degree of confidence to constitute an offset (Baber *et al*., 2021). Specifically:

- The benefits associated with the proposed habitat enhancement constitute like-for-like effects management in a broad sense, but do not constitute an ‘apples-for-apples' scenario for the purpose of biodiversity offset modelling. Adverse effects on marine biodiversity values will be addressed through positive effects on marine biodiversity values.
- There are potential (albeit low level) effects on biodiversity values that are difficult to detect or monitor, and for which the response to offsetting or compensation measures may be slow or uncertain (e.g. bird-roost enhancements).

Although biodiversity compensation does not require the same numerical rigour as offsetting, it is generally recognised that ecological outcomes are improved where offset principles are applied as a guideline when designing compensation packages.

The type and magnitude of proposed compensation measures will be guided by the application of a BCM (Baber *et al*., 2021).

[8] This principle will be addressed primarily in the Cultural Impact Assessment and integrated into the residual effects management approach. Similarly, other inter-related principles and disciplines, e.g., stormwater management and landscape design will be built into the overall residual effects management package for ecology.

6.3 Residual effects measures

The requirement for a Coastal Bird Management Plan was developed through the PPC88 process and was ultimately included in the Precinct Provisions. Specifically, the Precinct Provisions state:

> *An application for subdivision in the precinct adjoining the coastal marine area must be accompanied by a Coastal Bird Management Plan, addressing the following:*
>
> a *The control of mammalian predators along the coastal margin including dogs and domestic cats;*
>
> b *The enhancement of existing nesting and roosting sites in the adjacent coastal marine area including elevation and expansion of shell banks and invasive weed and mangrove management;*
>
> c *The enhancement and maintenance of high-quality coastal bird foraging habitat in the inter-tidal mud/sand flats within the adjacent coastal marine area including selective mangrove management;*
>
> d *Controls to minimise disturbance to roosting or nesting coastal birds; and*
>
> e *A framework for monitoring and adaptive management.*

As discussed in the PPC88 Marine EcIA (Appendix F), compensation measures that require ecological enhancement of habitats are consistent with approaches elsewhere; particular measures put forward include:

- Enhancement of the Waikopua Shellbanks. This habitat is in a degraded state and on a decline trajectory. This is due to encroachment by invasive weeds (e.g. pampas) that is preventing the use of some parts of the shellbank for roosting or nesting, and proliferation of mangroves immediately surrounding the shellbanks which inhibits suitability for roosting and nesting birds by compromising line of site. To this end, selective vegetation removal (mangroves and saline vegetation) and replanting of ground cover native species that introduce better line of sight will improve the quality of this habitat type both for roosting and nesting purposes.
- Mangrove management. Selective removal of mangroves and ongoing maintenance of seedlings is proposed to maintain quality foraging habitat at the mouth of the Waikopua Creek. Without intervention it is likely that mangroves will continue to expand seawards in this location, compromising foraging habitat quality and impinging on other habitats.
- Restoration and enhancement measures could also be undertaken at an embayment scale, including roost enhancement of shellbanks close to Motukaraka Island or at Porterfield Road Esplanade Reserve.

In conclusion, we consider it likely that all residual effects associated with the FTAA application can be adequately addressed through implementation of compensation measures to be outlined in the CBMP and following Biodiversity Compensation Modelling. Associated monitoring to verify that expected ecological outcomes have been realised and to guide adaptive management, will further ensure NNL for marine ecological values.

7 Summary and conclusions

Beachlands South Limited Partnership (BSLP) are lodging a substantive application under the Fast-track Approvals Act 2024 to enable the development of the Beachlands South Project

This Marine Ecological Impact Assessment (EcIA) has assessed the potential ecological effects associated with the Beachlands South Project, with particular focus on the proposed treated wastewater ocean outfall and diffuser within the Whitford Embayment. The assessment also summarises the marine ecological effects associated with the wider Project that were previously assessed as part of the PPC88 Marine EcIA, including construction earthworks, stormwater discharges and increased public access to the coastal environment.

Overall, the assessment concludes that the proposed wastewater infrastructure and associated discharges can be managed so that adverse effects on marine ecology are generally very low to low; refer to Table 7.1 below. An adaptive Marine Monitoring Programme is proposed to provide confidence in these conclusions and to enable future inclusion of EOC monitoring when regional or national guidelines become available in the future.

Residual effects associated with enabling the wider urban development have previously been identified and are addressed through the established Precinct provisions, ecological compensation framework and ongoing monitoring and adaptive management. Accordingly, we are satisfied that adverse effects to marine and coastal ecological values due to the Project can be adequately addressed through the effects management measures outlined and the established Precinct Provisions.

The additional investigations undertaken to assess the Fast-track application, including detailed assessment of the proposed wastewater outfall and diffuser, wastewater discharge modelling and supplementary marine ecological surveys, do not alter the conclusions of the PPC88 Marine EcIA. Rather, they provide further confidence that the proposed wastewater infrastructure has been appropriately designed and located to avoid or minimise adverse ecological effects.

Table 7.1: Summary of ecological values, magnitude of effects and overall ecological effects following the implementation of mitigation and management measures

Ecological characteristic	Ecological value	Magnitude of effect after measures to avoid, remedy of mitigate effects are applied	Potential overall level of residual effect on ecological values
Marine habitats	Subtidal sandy / muddy substrate **moderate** based on sediment and water quality, benthic infauna abundance and diversity, level of habitat modification.	**low**	**low**
	Subtidal / intertidal seagrass **high** based on Threat status – At Risk Declining (De Lange, 2023)	**negligible**	**low**

Ecological characteristic	Ecological value	Magnitude of effect after measures to avoid, remedy of mitigate effects are applied	Potential overall level of residual effect on ecological values
Seabirds	Due to the identification of the Hauraki Gulf as a nationally significant hotspot for seabirds, with a diverse species assemblage (with Threatened and At Risk species), proximity to island and mainland breeding sites and foraging capacity in productive waters, the ecological value of seabirds is **very high**. Based on the regional threat status the ecological value for kororā is **very high**.	**negligible**	**low**
Fish	Based on the potential high diversity and abundance of fish species, and the habitat available within Waikopua Creek and the wider Whitford embayment, the values in the marine receiving environment are considered **high** for fish.	**negligible**	**very low**
Marine mammals	Based on potential species diversity and abundance (with Threatened and At Risk species present in the inner Hauraki Gulf), resident populations and foraging potential in the Hauraki Gulf, the ecological value of marine mammals is **very high**.	**negligible**	**low**

8 Applicability

This report has been prepared for the exclusive use of our client Beachlands South Limited Partnership, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application under the Fast-track Approvals Act 2024 and that an Expert Panel will use this report for the purpose of assessing that application. We understand and agree that this report will be used by the Expert Panel in undertaking its regulatory functions.

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